



Aerospace Medicine  
and Biology  
A Continuing  
Bibliography  
with Indexes

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April 1987

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(NASA-SP-7011(296)) AEROSPACE MEDICINE AND  
BIOLOGY: A CONTINUING BIBLIOGRAPHY WITH  
INDEXES (SUPPLEMENT 296) (National  
Aeronautics and Space Administration) 67 p

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Aerospace Medicine and Biology

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# **AEROSPACE MEDICINE AND BIOLOGY**

**A CONTINUING BIBLIOGRAPHY  
WITH INDEXES**

**(Supplement 296)**

A selection of annotated references to unclassified reports and journal articles that were introduced into the NASA scientific and technical information system and announced in March 1987 in

- *Scientific and Technical Aerospace Reports (STAR)*
- *International Aerospace Abstracts (IAA).*



Scientific and Technical Information Branch 1987  
**National Aeronautics and Space Administration**  
Washington, DC

This supplement is available from the National Technical Information Service (NTIS), Springfield, Virginia 22161, price code A04.

# INTRODUCTION

This Supplement to *Aerospace Medicine and Biology* lists 171 reports, articles and other documents announced during March 1987 in *Scientific and Technical Aerospace Reports (STAR)* or in *International Aerospace Abstracts (IAA)*. The first issue of the bibliography was published in July 1964.

In its subject coverage, *Aerospace Medicine and Biology* concentrates on the biological, physiological, psychological, and environmental effects to which man is subjected during and following simulated or actual flight in the Earth's atmosphere or in interplanetary space. References describing similar effects of biological organisms of lower order are also included. Such related topics as sanitary problems, pharmacology, toxicology, safety and survival, life support systems, exobiology, and personnel factors receive appropriate attention. In general, emphasis is placed on applied research, but references to fundamental studies and theoretical principles related to experimental development also qualify for inclusion.

Each entry in the bibliography consists of a bibliographic citation accompanied in most cases by an abstract. The listing of the entries is arranged by *STAR* categories 51 through 55, the Life Sciences division. The citations, and abstracts when available, are reproduced exactly as they appeared originally in *IAA* or *STAR*, including the original accession numbers from the respective announcement journals. The *IAA* items will precede the *STAR* items within each category.

Seven indexes — subject, personal author, corporate source, foreign technology, contract, report number, and accession number — are included.

An annual index will be prepared at the end of the calendar year covering all documents listed in the 1987 Supplements.

Information on the availability of cited publications including addresses of organizations and NTIS price schedules is located at the back of this bibliography.

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## TYPICAL REPORT CITATION AND ABSTRACT

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|---------------------------|---|------------------------------|
| <b>ACCESSION NUMBER</b> → | <b>N87-11481*</b> # Umpqua Research Co., Myrtle Creek, Ore.               | ← <b>CORPORATE SOURCE</b>    |
| <b>TITLE</b> →            | <b>A PROTOTYPE SPACE FLIGHT INTRAVENOUS INJECTION SYSTEM Final Report</b> |                              |
| <b>AUTHOR</b> →           | G. V. COLOMBO May 1985 65 p   | ← <b>PUBLICATION DATE</b>    |
|                           | (Contract NAS9-16337)   | ← <b>AVAILABILITY SOURCE</b> |
| <b>REPORT NUMBERS</b> →   | (NASA-CR-171911; NAS 1.26:171911) Avail: NTIS HC A04/MF                   | ← <b>PRICE CODE</b>          |
| <b>COSATI CODE</b> →      | A01 CSCL 06E  |                              |

Medical emergencies, especially those resulting from accidents, frequently require the administration of intravenous fluids to replace lost body liquids. The development of a prototype space flight intravenous injection system is presented. The definition of requirements, injectable concentrates development, water polisher, reconstitution hardware development, administration hardware development, and prototype fabrication and testing are discussed.

B.G.

## TYPICAL JOURNAL ARTICLE CITATION AND ABSTRACT

**NASA SPONSORED**

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|                               |   |                           |
|-------------------------------|---|---------------------------|
| <b>ACCESSION NUMBER</b> →     | <b>A87-11660*</b> National Aeronautics and Space Administration, Ames Research Center, Moffett Field, Calif.    |                           |
| <b>TITLE</b> →                | <b>EFFECT OF ANTIGRAVITY SUIT INFLATION ON CARDIOVASCULAR, PRA, AND PVP RESPONSES IN HUMANS</b>                 |                           |
| <b>AUTHORS</b> →              | S. E. KRAVIK, L. C. KEIL, G. GEELEN, C. E. WADE, P. R. BARNES   |                           |
| <b>AUTHOR'S AFFILIATION</b> → | (NASA, Ames Research Center, Moffett Field; U.S. Army, Letterman Army Medical Center, San Francisco, CA) et al. | ← <b>JOURNAL TITLE</b>    |
|                               | Journal of Applied Physiology (ISSN 0161-7567), vol. 61, Aug. 1986, p. 766-774. refs                            | ← <b>PUBLICATION DATE</b> |

The effects of lower body and abdominal pressure, produced by antigravity suit inflation, on blood pressure, pulse rate, fluid and electrolyte shift, plasma vasopressin and plasma renin activity in humans in upright postures were studied. Five men and two women stood upright for 3 hr with the suit being either inflated or uninflated. In the control tests, the suit was inflated only during the latter part of the trials. Monitoring was carried out with a sphygmomanometer, with sensors for pulse rates, and using a photometer and osmometer to measure blood serum characteristics. The tests confirmed earlier findings that the anti-g suit eliminates increases in plasma renin activity. Also, the headward redistribution of blood obtained in the tests commends the anti-g suit as an alternative to water immersion or bed rest for initial weightlessness studies.

M.S.K.

# AEROSPACE MEDICINE AND BIOLOGY

*A Continuing Bibliography (Suppl. 296)*

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## LIFE SCIENCES (GENERAL)

**A87-17706**

### **REGULATION OF CARBOHYDRATE METABOLISM [REGULATSIIA UGLEVODNOGO OBmena]**

I. N. KENDYSH Moscow, Izdatel'stvo Meditsina, 1985, 272 p. In Russian. refs

The substrate and hormonal factors controlling the metabolism of glucose and glycogen are discussed, together with the pharmacologic regulation of gluconeogenesis and metabolic changes caused by different physiological conditions. Consideration is given to the effects on gluconeogenesis of insulin, STH, glucagon, catecholamines, and glucocorticosteroids. Abnormalities of glucose metabolism observed under conditions of diabetes, thyrotoxicosis, Addison disease, Itsenko-Cushing syndrome, metabolic acidosis, obesity, and starvation are described. I.S.

**A87-17732**

### **NEURONAL ADAPTATION AND ULTRASTRUCTURE [ADAPTATSIIA I UL'TRASTRUKTURA NEIRONA]**

D. A. MOSHKOV Moscow, Izdatel'stvo Nauka, 1985, 200 p. In Russian. refs

Studies of ultrastructural changes and physiological reactions during exhaustive stimulation of the Mauthner neurons (MNs) and middle brain were performed on several fish species, tadpoles, and fish larvae. The results have revealed the presence of correlations between the morphological and functional restructuring of neuronal synapses during the exhaustive stimulation. It is suggested that there exists a fundamental unifying principle of morphofunctional organization that controls synaptic transmission during a particular condition. I.S.

**A87-17787**

### **EFFECTS OF POSITIVE END-EXPIRATORY PRESSURE ON THE RIGHT VENTRICLE**

R. J. HENNING (Case Western Reserve University, Cleveland, OH) Journal of Applied Physiology (ISSN 0161-7567), vol. 61, Sept. 1986, p. 819-826. refs

The mechanisms by which the use of positive end-expiratory pressure (PEEP) in subjects who require mechanical ventilation leads to the decrease of cardiac output were investigated using dogs maintained on positive-pressure ventilation. Transmural cardiac pressures, stroke volume, right ventricular volume, and lung water content were measured in normal dogs and in dogs with oleic acid-induced pulmonary edema (PE). Twenty cm H<sub>2</sub>O PEEP was found to significantly increase pleural pressure and pulmonary vascular resistance but to decrease right ventricular volume, stroke volume, and mean arterial pressure in both normal and PE dogs. I.S.

**A87-17788**

### **ENDURANCE EXERCISE TRAINING REDUCES LACTATE PRODUCTION**

R. J. FAVIER, S. H. CONSTABLE, M. CHEN, and J. O. HOLLOSZY (Washington University, Saint Louis, MO) Journal of Applied Physiology (ISSN 0161-7567), vol. 61, Sept. 1986, p. 885-889. Research supported by the Fondation pour la Recherche Medicale, Philippe Foundation, and NATO. refs  
(Contract NIH-AG-00425; NIH-AM-18986)

The effect of endurance training on lactic acid production in contracting muscles was studied, using in situ stimulated gastrocnemius-plantaris-soleus muscle group in trained and untrained rats. Upon stimulation, the muscles of trained rats have displayed increases of lactic acid that were 28 to 50 percent less than the increases observed in untrained rats. The reduction in lactate accumulation occurring in the muscles in response to training was roughly proportional to the degree of muscle glycogen sparing observed in these rats, indicating that endurance training induces adaptations that result in a slower production of lactate during contractile activity. I.S.

**A87-17794**

### **SIMULTANEOUS DETERMINATION OF FLUID SHIFTS DURING THERMAL STRESS IN A SMALL-ANIMAL MODEL**

M. J. DURKOT, O. MARTINEZ, D. BROOKS-MCQUADE, and R. FRANCESCONI (U.S. Army, Research Institute of Environmental Medicine, Natick, MA) Journal of Applied Physiology (ISSN 0161-7567), vol. 61, Sept. 1986, p. 1031-1034. refs

**A87-17795**

### **A DELIVERY-INDEPENDENT BLOOD FLOW EFFECT ON SKELETAL MUSCLE FATIGUE**

J. K. BARCLAY (Guelph, University, Canada) Journal of Applied Physiology (ISSN 0161-7567), vol. 61, Sept. 1986, p. 1084-1090. refs

The hypothesis that hyperfusion decreases muscle fatigue by increasing oxygen delivery and plasma-borne substrate delivery to the muscle was tested using in situ preparations of canine gastrocnemius-plantaris. It was found that over the 20-min experimental period the developed muscle tension decreased about 15 percent with low O<sub>2</sub>/high flow, and about 16 percent with dilute plasma/high flow conditions. Muscle tension decreased by about 28 percent with both high O<sub>2</sub>/low flow and constant plasma flow. The results indicate that hyperperfusion decreases fatigue by a mechanism independent of increased O<sub>2</sub> and substrate delivery. I.S.

**A87-18360**

### **HYPOGRAVIC EFFECTS ON BEHAVIOR AND BRAIN ACTIVITY OF CARP IN A BALLOON MICROGRAVITY EXPERIMENT**

S. MORI, A. TAKABAYASHI, S. TAKAGI (Nagoya University, Japan), G. MITARAI (Chukyo University, Toyoda, Japan), S. USUI (Toyoashi University of Technology, Japan) et al. IN: International Symposium on Space Technology and Science, 14th, Tokyo, Japan, May 27-June 1, 1984, Proceedings. Tokyo, AGNE Publishing, Inc., 1984, p. 1235-1240.

A87-18399

**EFFECTS OF DIRECTION OF CENTRIFUGAL FORCES UPON CARDIAC AND PULMONARY FUNCTIONS OF HAMSTERS**

Y. MIZUNO, H. SATAKE, S. UEKI, H. URANO, Y. SEKIMOTO (Gifu University, Japan) et al. IN: International Symposium on Space Technology and Science, 14th, Tokyo, Japan, May 27-June 1, 1984, Proceedings. Tokyo, AGNE Publishing, Inc., 1984, p. 1559-1564. refs

A87-18559

**VIRUSES FROM SPACE AND RELATED MATTERS**

F. HOYLE, C. WICRAMASINGHE, and J. WATKINS Cardiff, Wales, University College Cardiff Press, 1986, 127 p. refs

It is proposed that viruses and bacteria responsible for epidemic diseases of plants and animals arrive from space. Evidence that these diseases are not, at least in the first instance, due to person-to-person transmission is presented. It is argued that smallpox was the cause of the Athenian epidemic of 430 B.C.

C.D.

A87-18655

**MEDIATORY FUNCTION OF LIPOXYGENASE ENZYME SYSTEMS AS MOLECULAR FACTORS UNDER CONDITIONS OF IONIZING RADIATION [MEDIATORNAIA FUNKTSIIA MOLEKULIARNYKH FAKTOROV-LIPOKSIGENAZNYKH FERMENTNYKH SISTEM PRI VOZDEISTVII IONIZIRUIUSHCHEI RADIATSII]**

E. V. BUDNITSKAIA (AN SSSR, Institut Biokhimii, Moscow, USSR) Radiobiologiya (ISSN 0033-8192), vol. 26, July-Aug. 1986, p. 435-446. In Russian. refs

Results of studies concerning the regulatory and mediatory functions of lipoxygenase (LOG) systems in animals and plants affected by ionizing radiation are presented together with recent data concerning the biological role of leukotrienes (LTs). The structure and function of LTs are described, with special attention given to their role in inflammatory and hypersensitivity reactions to radiation.

I.S.

A87-18656

**OPTIMIZATION OF THE COMPOSITION OF THE RADIOPROTECTIVE COMPLEX APAETP + MEXAMINE AND AN ANALYSIS OF ITS EFFECT [OPTIMIZATSIYA SOSTAVA RADIOZASHCHITNOGO KOMPLEKSA APAETP + MEKSAMIN I ANALIZ EGO DEISTVIA]**

V. G. VLADIMIROV, I. P. KAMENKO, G. A. PODDUBSKII, S. M. SMIRNOVA, and L. G. TARNOPOLSKAIA (Voenno-Meditsinskaya Akademiya, Leningrad, USSR) Radiobiologiya (ISSN 0033-8192), vol. 26, July-Aug. 1986, p. 495-498. In Russian. refs

Mathematical experiment theory was used to determine the optimum composition of the two variants in the radioprotective complex of mexamine and S-(omega-aminopropyl)-beta-aminoethylthiophosphate (APAETP). APAETP and mexamine were administered in different doses and dose ratios to mice 20 min before gamma-irradiation, and the protective effect was determined according to the survival rates.

I.S.

A87-18657

**MODIFICATION BY A MESOPORPHYRIN-IX DERIVATIVE OF DAMAGES INDUCED IN CHINESE HAMSTER CELLS BY HIGH-ENERGY HELIUM ION AND PROTONS [MODIFIKATSIYA PROIZVODNYM MEZOPORFIRINA-IX PORAZHENII KLETOK KITAISKOGO KHOMIACHKA VYSOKOENERGETICHESKIMI IONAMI GELIIA I PROTONAMI]**

E. I. IARTSEV, G. N. LOGINOVA, V. N. GERASIMENKO, S. D. NOVOSELTSEVA, and G. B. MARAVIN (Institut Biologicheskoi Fiziki, Moscow, USSR) Radiobiologiya (ISSN 0033-8192), vol. 26, July-Aug. 1986, p. 528-531. In Russian. refs

The protective effect of mesoporphyrin XIX (an aminoalkyl derivative of mesoporphyrin IX) was investigated using Chinese hamster fibroblast cultures subjected to irradiation by He ions (4 GeV), protons (9 GeV), and gamma- and X-rays. The damaging effects of both the high-energy particles and the standard radiation

were significantly less when mesoporphyrin-XIX was included in the culture media. The effect was maximal when the cells were preincubated (rather than postradiation-treated) with the compound.

I.S.

A87-18658

**THE EFFECTS OF THE ELECTRON AND STERIC INTERACTIONS ON THE RADIOPROTECTIVE PROPERTIES OF INDOLYLALKYLAMINES [VLIANIE ELEKTRONNYKH I STERICHESSKIKH VZAIMODEISTVII NA PROTIVOLUCHEVYE SVOISTVA INDOLILALKILAMINOV]**

V. K. MUKHOMOROV (Voenno-Meditsinskaya Akademiya, Leningrad, USSR) Radiobiologiya (ISSN 0033-8192), vol. 26, July-Aug. 1986, p. 557-559. In Russian. refs

Results obtained on the radioprotective activity of 35 indolylalkylamine derivatives, differing in the chemical nature of the substituents and in the substitution sites, are discussed. It was shown that the steric and the charge properties of a substituent are the factors determining the protective efficiency. A linear correlation expression was obtained relating the protective activity of a compound to its structural and charge parameters.

I.S.

A87-18659

**THE RELATIONSHIP BETWEEN THE ELECTRONIC AND INFORMATIONAL FACTORS AND THE RADIOPROTECTIVE EFFICIENCY OF SULFUR-CONTAINING COMPOUNDS [SVIAZ' ELEKTRONNOGO I INFORMATSIONNOGO FAKTOROV S RADIOZASHCHITNOI'EFFEKTIVNOST'IU SEROSODERZHA-SHCHIKH SOEDINENII]**

V. K. MUKHOMOROV (Voenno-Meditsinskaya Akademiya, Leningrad, USSR) Radiobiologiya (ISSN 0033-8192), vol. 26, July-Aug. 1986, p. 560-563. In Russian. refs

A relationship was found between the radioprotective properties of sixty sulfur-containing compounds evaluated by Sweeney (1979) and their structural properties, using a parameter defined in terms of the electronic properties of the compound. This parameter is, in turn, related to the Shannon information function.

I.S.

A87-19028

**RAMAN SPECTROSCOPY OF LIPOSOMES EXPOSED TO MILLIMETER WAVES**

L. FURIA, O. P. GANDHI, R. E. BENNER, and D. W. HILL (Utah, University, Salt Lake City) Journal of Applied Physics (ISSN 0021-8979), vol. 60, Oct. 15, 1986, p. 2991-2994. refs (Contract F33615-84-K-0613)

Several biological effects resulting from exposure to millimeter waves have been reported. In an attempt to determine if millimeter waves might affect the conformational state of membranes, sonicated liposomes have been irradiated with millimeter waves at 41.650 GHz, stabilized in frequency to plus or minus 50 Hz. Raman spectra from the lipid vesicles were then collected in the conformational and in the C-H stretching region. No changes in either the Raman peak locations or relative intensities were detected upon millimeter-wave irradiation, either below or above the transition temperature of the phospholipid (41 C). Author

A87-19062

**EFFECT OF AGE, WEIGHT, AND METABOLIC RATE ON ENDURANCE, HYPERTHERMIA, AND HEATSTROKE MORTALITY IN A SMALL ANIMAL MODEL**

M. J. DURKOT, R. P. FRANCESCONI, and R. W. HUBBARD (U.S. Army, Research Institute of Environmental Medicine, Natick, MA) Aviation, Space, and Environmental Medicine (ISSN 0095-6562), vol. 57, Oct. 1986, p. 974-979. refs

The effects of age, body weight, and metabolic efficiency on endurance, thermoregulation, and heat stroke mortality was investigated in rats exercised (6-deg-incline treadmill) at 26 C. Light (250 g) rats were able to run longer (221 min), had the lowest rate of heat gain, and experienced lowest heat-stroke mortality, despite a relatively large proportion of fluid loss. On the other hand, the heavier and older rats (350 g - 12 week, 500 g - 16 week, and 500 g - 30 week) demonstrated significantly reduced run times (54 min for 500 g - 30-week rats), more rapid accumulation



of metabolic heat, and much higher mortalities, despite lower percentages of fluid loss. I.S.

**N87-13579#** University of Electro-Communications, Tokyo (Japan).

**EFFECT OF ELECTRIC OR MAGNETIC FIELD ON PLANT GROWTH**

N. KOKUBU and C. Y. CHAN *In its* Reports of the University of Electro-Communications, Volume 37, No. 1 p 53-59 Sep. 1986 In JAPANESE; ENGLISH summary

Avail: NTIS HC A07/MF A01

The effects of electric or magnetic fields on plant growth are studied using bean sprouts (mung bean) as the experimental object. The details of apparatus and method of experiment are described. The results of experiments deal statistically with Wilcoxon's test. Under the conditions of these experiments, no obvious effects of electric or magnetic field on plant growth were recognized.

Author

**N87-13980#** Joint Publications Research Service, Arlington, Va. **METHODS FOR MEASURING EXTERNAL RESPIRATION AND GAS EXCHANGE PARAMETERS OF MACACA RHESUS MONKEYS**

V. I. KOROLKOV, Y. P. GORA, and A. Y. SEVERIN *In its* USSR Report: Space Biology and Aerospace Medicine, Vol. 19, No. 1, January - February 1985 (JPRS-USB-85-003) p 117-120 18 Apr. 1985 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina (Moscow, USSR), v. 19, no. 1, Jan. - Feb. 1985 p 80-82

Avail: NTIS HC A08/MF A01

With the development of cosmonautics, it is becoming promising to use primates, which are biological objects that are phylogenetically the closest to man, for investigation of the effects of flight factors on physiological functions. Changes in exchange of gases and energy metabolism serve as an important indicator of dynamics of metabolism. Heretofore, primates were used for investigation of changes in respiratory function under various conditions: under the effect of x-radiation, toxic gases, smoking, allergy, asthma, etc. But as yet no convenient and labor-efficient methods have been developed for studying external respiration parameters in lower monkeys. The objective here was to compare different methods of measuring parameters of external respiration and gas exchange in the Macaca rhesus under normal conditions and anesthesia.

Author

**N87-13981#** Joint Publications Research Service, Arlington, Va. **INVESTIGATION OF GROWTH RATE OF METHANE-ASSIMILATION BACTERIA IN WEIGHTLESSNESS**

M. G. TAIRBEKOV, G. P. PARFENOV, K. ZATTLER, E. KRANTZ, L. WUNSCH, A. SCHLUTTING, and G. I. MALYSHEVA *In its* USSR Report: Space Biology and Aerospace Medicine, Vol. 19, No. 1, January - February 1985 (JPRS-USB-85-003) p 121-124 18 Apr. 1985 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina (Moscow, USSR), v. 19, no. 1, Jan. - Feb. 1985 p 83-84

Avail: NTIS HC A08/MF A01

Investigation of structural and functional distinctions of methane assimilating bacteria in weightlessness is of interest from the standpoint of making practical use of them in a biological life-support system as protein producers. The distinctive feature of these bacteria is the structural complexity of their cytoplasmic membranes, which is directly related to the cell's ability to assimilate methane and synthesize protein.

Author

**N87-14830#** Naval Medical Research Inst., Bethesda, Md. **INVESTIGATION OF POTENTIAL BEHAVIORAL EFFECTS OF EXPOSURE TO 60 HZ ELECTROMAGNETIC FIELDS Final Report, Mar. 1982 - Apr. 1985**

J. R. THOMAS, J. SCHROT, and A. LIBOFF Dec. 1985 69 p (AD-A169650; NMRI-85-63) Avail: NTIS HC A04/MF A01 CSCL 05J

To analyze potential behavioral effects produced by exposures to 60 Hz electric and magnetic fields, animals were exposed to a

range of linearly polarized magnetic fields of .5 to 5 gauss, with and without the combination of a 1 kv/m electric field. The animals performed on a multiple fixed-ratio (FR) differential reinforcement of low rate (DRL) reinforcement schedule that required responding on a lever to produce food pellets. The effects of the above fields were also studied on the multiple FR DRL schedule performance of animals administered representative drugs from two psychoactive drug classes, amphetamine and chlordiazepoxide. Under the present experimental exposure conditions and durations, exposures to the 60 Hz electromagnetic fields produced no systematic changes in the behavior of the animals of the multiple FR DRL schedule. No systematic effects were observed on the behavioral effects of either amphetamine or chlordiazepoxide, at the doses explored, by any of the exposures to the magnetic fields alone or in combination with the electric field. When animals were exposed to a low-level (.5 gauss) 60 Hz magnetic field combined with a low-level static magnetic field they consistently exhibited changes in the rate and pattern of responding during the DRL component of the multiple FR DRL reinforcement schedule. GRA

**N87-14831#** Washington Univ., Seattle.

**AFFERENT MECHANISMS OF MICROWAVE-INDUCED BIOLOGICAL EFFECTS Annual Report, 1 Jun. 1985 - 31 May 1986**

H. LAI Jul. 1986 4 p

(Contract N00014-80-C-0354; RR0-4108)

(AD-A169979) Avail: NTIS HC A02/MF A01 CSCL 06R

We studied the effects of 2450 MHz circularly polarized microwave irradiation on central nervous system functions. Pulsed (microsecond, 500 pps) microwaves decreased high affinity sodium-dependent choline uptake in the hippocampus and frontal cortex of the rat. The effect on hippocampal choline uptake was blocked by pretreatment with narcotic antagonists. Continuous-wave microwaves of the same power density decreased choline uptake in the frontal cortex only. Furthermore, we found that the effects of pulsed microwaves on central cholinergic activity are classically conditionable to cues in the exposure environment. The hypothesis that some of the neurological effects of pulsed microwave irradiation are caused by its effect on the auditory system was investigated. Effects of pink noise and pulsed microwaves were compared. GRA

**N87-14832#** Army Medical Research Inst. of Infectious Diseases, Fort Detrick, Md.

**TECHNIQUE FOR CARDIOVASCULAR MONITORING IN AWAKE TETHERED RATS Interim Report**

G. W. PARKER and D. G. MARTIN 16 Jul. 1986 25 p

(AD-A170246) Avail: NTIS HC A02/MF A01 CSCL 06N

We have developed a tethering system for use in awake, freely moving rats that allows for repeated measurement of either cardiac output or direct arterial blood pressure and electrocardiogram (ECG). Cardiac output was measured by the thermodilution technique by using a thermocouple probe and polyethylene tubing surgically implanted in the aortic arch and superior vena cava, respectively. Arterial blood pressure and ECGs were monitored via a carotid arterial catheter and teflon-coated, stainless steel wire electrodes placed subcutaneously on the extremities. The catheters, wires, and thermocouple probe were passed subcutaneously to the dorsal cervical area and exteriorized. The animals were then attached to a rodent jacket/spring tether system and allowed to recover for at least 24 to 48 hours before experimental procedures were initiated. In 49 rats, arterial blood pressures and ECGs were analyzed. Similarly, cardiac output was measured in 27 rats. GRA

**N87-14833#** Oak Ridge National Lab., Tenn. Chemical Technology Div.

**PHOTOBIOLOGICAL HYDROGEN PRODUCTION IN GREEN ALGAE AND PHOTOSYNTHETIC BACTERIA**

E. GREENBAUM 1986 3 p Presented at the GRI Basic Research Contractor's Review Meeting on Gaseous Fuel Synthesis From Inorganic Resources, Palo Alto, Calif., 15 Oct. 1986 (Contract DE-AC05-84OR-21400)

(DE86-015918; CONF-8610137-1) Avail: NTIS HC A02/MF A01

We have shown that, under appropriate physiological conditions, certain freshwater and marine green algae are capable of splitting water to molecular hydrogen and oxygen in a sustained steady-state reaction. In these algae, the gaseous-fuel-producing reaction can be driven by light throughout the visible portion of the solar emission spectrum, including the long wavelength (red) 700-nm region. No external energy sources are required. DOE

**N87-14834#** European Space Agency, Paris (France).  
**ON THE EFFECTS OF X IRRADIATION ON BACILLUS SUBTILIS SPORES IN A DRY AND WET SYSTEM**

E. WOIZENKO Apr. 1986 78 p Original language document was announced as N86-15864

(ESA-TT-968; DFVLR-FB-85-44; ETN-87-98819) Avail: NTIS HC A05/MF A01; original German version available from DFVLR, Cologne, West Germany DM 29

*Bacillus subtilis* spores were irradiated to study the influence of intracellular water and to explain the modulating role of water in the development of biological radiation damage. The effects of repair deficiency in mutants regarding sensitivity to radiation in dry and wet systems were studied to explain the damage process in correlation with cell water content. The experiments were verified in multiplication rate and lag phase curves. Wild and mutant species are more sensitive to ionizing radiation in a dry medium than in a wet medium. The water content used as a radiation protective substance reduces inactivation. Rec<sup>+</sup> species (wild species) is more sensitive to ionizing radiation under extremely dry conditions and in a vacuum than Rec<sup>-</sup> species (mutants) due to a reduced repair ability. Recspecies deficient in the Rec A gene develop other repair processes to compensate for damage. The results show the variety of the cell repair processes. ESA

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## AEROSPACE MEDICINE

Includes physiological factors; biological effects of radiation; and effects of weightlessness on man and animals.

**A87-16424\*** Stanford Univ., Calif.

**ANALYSIS OF THE RETINEX THEORY OF COLOR VISION**

D. H. BRAINARD and B. A. WANDELL (Stanford University, CA) Optical Society of America, Journal, A: Optics and Image Science (ISSN 0740-3232), vol. 3, Oct. 1986, p. 1651-1661. refs (Contract NIH-2-R01-EY-03164; NCC2-307)

Land's (1983) retinex algorithm is a model of human color constancy. The retinex algorithm is analyzed and its general properties are discussed. It is shown that the algorithm is too sensitive to changes in the color of nearby objects to serve as an adequate model of human color constancy. Author

**A87-16425**

**EVALUATION OF LINEAR MODELS OF SURFACE SPECTRAL REFLECTANCE WITH SMALL NUMBERS OF PARAMETERS**

L. T. MALONEY (Michigan, University, Ann Arbor) Optical Society of America, Journal, A: Optics and Image Science (ISSN 0740-3232), vol. 3, Oct. 1986, p. 1673-1683. refs

Three conjectures were tested: (1) that surface spectral reflectances fall within a linear model with a small number of parameters, (2) that empirical surface reflectances fall within a linear model composed of band-limited functions with a small

number of parameters, and (3) that the shape of the spectral sensitivity curves of human vision enhances the fit between empirical surface reflectances and a linear model. The results of an analysis of empirical surface spectral reflectances have shown that the first two conjectures hold. The linear models derived, taking into account human visual sensitivity, provided excellent fits to the data with as few as three or four parameters, confirming the third conjecture. I.S.

**A87-17789**

**BREATHLESSNESS DURING EXERCISE WITH AND WITHOUT RESISTIVE LOADING**

A. EL-MANSHAWI, K. J. KILLIAN, E. SUMMERS, and N. L. JONES (McMaster University, Medical Centre, Hamilton, Canada) Journal of Applied Physiology (ISSN 0161-7567), vol. 61, Sept. 1986, p. 896-905. refs

The intensity of breathlessness associated with exercise and respiratory resistive loading was quantified in normal subjects in order to isolate the quantitative contributions to breathlessness of inspiratory pressure, length, velocity, and frequency of inspiratory muscle shortening and duty cycle. Results suggest that peak pressure, velocity of inspiratory muscle shortening, the ratio of inspiratory duration to total breath duration, and the frequency of breathing contribute independently and collectively to breathlessness. I.S.

**A87-17790**

**VENTILATORY RESPONSE TO SUSTAINED HYPOXIA IN NORMAL ADULTS**

P. A. EASTON, L. J. SLYKERMAN, and N. R. ANTHONISEN (Manitoba, University, Winnipeg, Canada) Journal of Applied Physiology (ISSN 0161-7567), vol. 61, Sept. 1986, p. 906-911. Research supported by the Medical Research Council of Canada. refs

In view of the evidence by Kagawa et al. (1982) and Weil and Zwillich (1976) that adult ventilation during hypoxia may have some attributes of a biphasic response, the ventilatory response of normal adults to isocapnic hypoxia was characterized. Evaluation of breathing pattern revealed that during constant hypoxia there was little alteration in respiratory timing, and that the changes in the inspiratory minute ventilation were related to significant alterations in tidal volume and mean inspiratory flow. It was concluded that ventilatory response to hypoxia in adults is not sustained; it exhibits some biphasic features similar to the neonatal hypoxic response. I.S.

**A87-17791\*** Johns Hopkins Medical Institutions, Baltimore, Md.  
**EFFECT OF PROLONGED BED REST ON LUNG VOLUME IN NORMAL INDIVIDUALS**

W. S. BECKETT, N. B. VROMAN, D. NIGRO, S. THOMPSON-GORMAN, J. E. WILKERSON (Johns Hopkins Medical Institutions, Baltimore, MD) et al. Journal of Applied Physiology (ISSN 0161-7567), vol. 61, Sept. 1986, p. 919-925. NASA-PHS-supported research. refs (Contract NIH-HL-10342; NIH-HL-07534)

The effect of prolonged bed rest on the lung function was studied by measuring forced vital capacity (FVC) and total lung capacity (TLC) in normal subjects before, during, and after 11- to 12-day rest periods. It was found that both FVC and TLC increased during bed rest (compared with the ambulatory controls), while residual volume and functional residual capacity of the respiratory system did not change. It is concluded that the increase in TLC by prolonged bed rest is not dependent on alterations in plasma volume. I.S.

**A87-17792****THERMOREGULATION, METABOLISM, AND STAGES OF SLEEP IN COLD-EXPOSED MEN**

J. W. PALCA, J. M. WALKER, and R. J. BERGER (California, University, Santa Cruz) *Journal of Applied Physiology* (ISSN 0161-7567), vol. 61, Sept. 1986, p. 940-947. refs  
(Contract NIH-GM-23694)

Human subjects selected for their ability to sleep in the cold were exposed to an ambient temperature of 21 C for five consecutive nights to measure thermoregulatory variables during REM sleep periods of normal duration. It is concluded that unsuppressed REM sleep in association with peripheral vasoconstriction and increased tympanic temperature in cold-exposed humans does not signify an inhibition of thermoregulation during this sleep stage as has been observed in other mammals. I.F.

**A87-17793\*** Arizona Univ., Tucson.**PLASMA ALDOSTERONE AND SWEAT SODIUM CONCENTRATIONS AFTER EXERCISE AND HEAT ACCLIMATION**

C. R. KIRBY (Arizona, University, Tucson) and V. A. CONVERTINO (Bionetics Corp., Cocoa Beach, FL) *Journal of Applied Physiology* (ISSN 0161-7567), vol. 61, Sept. 1986, p. 967-970. Research supported by the University of Arizona. refs  
(Contract NCA2-OR-745-911)

The relationship between plasma aldosterone levels and sweat sodium excretion after chronic exercise and heat acclimation was investigated, using subjects exercised, at 40 C and 45 percent humidity, for 2 h/day on ten consecutive days at 45 percent of their maximal oxygen uptake. The data indicate that, following heat acclimation, plasma aldosterone concentrations decrease, and that the eccrine gland responsiveness to aldosterone, as represented by sweat sodium reabsorption, may be augmented through exercise and heat acclimation. I.S.

**A87-18397\*** National Aeronautics and Space Administration. John F. Kennedy Space Center, Cocoa Beach, Fla.**OPERATIONAL MEDICINE IN SPACE STATION ERA**

S. FURUKAWA (NASA, Kennedy Space Center; McDonnell Douglas Technical Services, Co., Cocoa Beach, FL) and P. BUCHANAN (NASA, Kennedy Space Center, Cocoa Beach, FL) IN: *International Symposium on Space Technology and Science*, 14th, Tokyo, Japan, May 27-June 1, 1984, Proceedings. Tokyo, AGNE Publishing, Inc., 1984, p. 1541-1551. refs

Medical considerations for long duration manned space missions are examined. The requirements and hardware for medical operations on the Space Station are diagrammatically presented. The physiological and psychological changes that have been observed during space flights are discussed. Crew health maintenance and medical care in the Space Station environment require earth-based and in flight continuity. It is also necessary to identify the appropriate zero-G therapeutic methods for treating a patient. Techniques for transferring patients in orbit and to earth are studied. Considerations are given to control and life support systems and data management for medical operations. I.F.

**A87-18398****POST-HYPODYNAMICS CHANGE RATE OF ORTHOSTATIC TOLERABILITY AS A FUNCTION OF WIDER RANGE PHYSICAL FITNESS**

H. SAIKI, M. NAKAYA, M. SUDOH, M. ABE, M. KOHNO (Jikei University, Tokyo, Japan) et al. IN: *International Symposium on Space Technology and Science*, 14th, Tokyo, Japan, May 27-June 1, 1984, Proceedings. Tokyo, AGNE Publishing, Inc., 1984, p. 1553-1557. refs

Water immersion experiments were conducted in order to study human orthostatic tolerance during hypodynamics exposure. The relationships between physical fitness and orthostatic tolerability following typical daily conditions and hypodynamics conditions are examined. The maximum amount of oxygen consumption, anaerobic power, blood pressure, pulse rate, urine volumes, and urinary excretion of 17-OHCS, Na(+), K(+), Ca(2+), and

catecholamines for 31 male subjects were evaluated. A lower orthostatic tolerability is detected at the higher oxygen consumption level until about 53 ml/kg min in maximum oxygen consumption level, and above 53 ml/kg min in maximum oxygen consumption level the reverse relationship between orthostatic tolerability and oxygen consumption is observed. I.F.

**A87-19058****SPONTANEOUS PNEUMOTHORAX IN THE USAF AIRCREW POPULATION - A RETROSPECTIVE STUDY**

V. M. VOGEL and R. ANTHRACITE (U.S. Navy, Naval Hospital, Corpus Christi, TX) *Aviation, Space, and Environmental Medicine* (ISSN 0095-6562), vol. 57, Oct. 1986, p. 939-949. refs

Spontaneous pneumothorax (SP) is infrequently diagnosed in aircrew personnel. However, once it is diagnosed, aircrew disposition becomes a serious concern. To evaluate this problem, a literature review was conducted to put the disease into proper perspective. A questionnaire was then sent to all aircrew in the United States Air Force waiver file who had suffered SP in order to gain a retrospective view of problems and situations encountered. The following areas were investigated: recurrences, height, weight, age, smoking history, initial medical management, symptomatology, activity at time of occurrence, relationship to flight duties, treatment given and personal/family history of lung disease. It is concluded that SP is an unrecognized hazard to aircrew personnel. Once an SP has been diagnosed in an individual, he/she should be grounded from further flight duties until either 9 years have elapsed without a recurrence or there has been a bilateral parietal pleurectomy. Author

**A87-19060****RENIN, ALDOSTERONE, AND VASOPRESSIN RESPONSES TO HYPOXIA DURING 6 HOURS OF MILD EXERCISE**

R. T. MEEHAN (Iowa, University, Iowa City) *Aviation, Space, and Environmental Medicine* (ISSN 0095-6562), vol. 57, Oct. 1986, p. 960-965. refs  
(Contract NIH-RR-59)

The effect of hypoxia (12 percent O<sub>2</sub>) on plasma renin (PRA), aldosterone (PA), and arginine vasopressin (AVP) levels were evaluated in male subjects during 6-h exercise on a treadmill (0 grade, 1 mph). Controls were breathing room air (21 percent O<sub>2</sub>). In both groups, during fluid, Na(+), and K(+) steady-state conditions, 6 h of mild sustained exercise resulted in decreased PRA and PA levels and prevented the normal diurnal variation of cortisol. Despite a slightly reduced mean arterial pressure, hypoxia per se (under the conditions of normal hydration) did not produce a significant difference in either PRA, PA, or AVP levels. I.S.

**A87-19061****MALE-FEMALE RESPONSES IN VARIOUS BODY TEMPERATURES DURING AND FOLLOWING EXERCISE IN COLD AIR**

C. A. WALSH and T. E. GRAHAM (Guelph, University, Canada) *Aviation, Space, and Environmental Medicine* (ISSN 0095-6562), vol. 57, Oct. 1986, p. 966-973. refs

Thermal responses of male and female subjects (M and F, respectively) to cold working environments (3 h of daily intermittent exercise at +10, +3.5, -3.5, and -10 C) were compared to establish whether facial and/or finger temperatures demonstrated sex differences. The thermal responses during rewarming (1 h at +21 C) were also studied to evaluate sex differences in afterdrop. The F had lower T<sub>sk</sub> in every test, but finger, nose, and chin temperatures were never lower than that in M. I.S.

**A87-19063****ACCELERATION TOLERANCE OF ASYMPTOMATIC AIRCREW WITH MITRAL VALVE PROLAPSE**

J. E. WHINNERY (USAF, School of Aerospace Medicine, Brooks AFB, TX) *Aviation, Space, and Environmental Medicine* (ISSN 0095-6562), vol. 57, Oct. 1986, p. 986-992. refs

Using the USAF School of Aerospace Medicine human centrifuge, 78 asymptomatic USAF aircrewmembers with auscultatory and/or echocardiographic evidence of mitral valve prolapse (MVP)

were evaluated for tolerance to +Gz stress. Both rapid (1G/s) and gradual (1G/15s) onset acceleration profiles were used to determine +Gz tolerance. There were no unusual characteristics, among the clinical parameters measured, which allowed separation of individuals with MVP into subgroups with altered +Gz tolerance. The MVP group was found to have a normal response to gradual onset +Gz stress, both while relaxed and when performing a protective straining maneuver. Author

**A87-19065****+GZ-INDUCED LOSS OF CONSCIOUSNESS IN UNDERGRADUATE PILOT TRAINING**

J. E. WHINNERY (USAF, School of Aerospace Medicine, Brooks AFB, TX) Aviation, Space, and Environmental Medicine (ISSN 0095-6562), vol. 57, Oct. 1986, p. 997-999.

Class C physiologic incident reports during undergraduate pilot training (UPT) revealed that 1.7 episodes of G-induced loss of consciousness (LOC) occurred monthly in 1980-1984. The mean +Gz for the LOC episodes was +3.8 Gz; the minimum, +2.0 Gz. The mean time of total incapacitation was 12.0 s (maximum, 180.0 s) as subjectively estimated by the aircrew. Improper performance of the anti-G straining maneuver was the most common etiology of the LOC episodes. Symptoms associated with the LOC included complete unawareness of the episode, disorientation, confusion, tingling in the extremities, and flail-type movements of the extremities. The most common aerobatic maneuver causing LOC (30 percent of the episodes) was the split-S. Safety within the UPT program could potentially be enhanced by ensuring that instructor pilots know how to most efficiently perform the protective anti-G straining maneuvers and recognize the symptoms associated with G-induced LOC. Author

**A87-19066\*** National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.

**CARDIOVASCULAR RESEARCH IN SPACE - CONSIDERATIONS FOR THE DESIGN OF THE HUMAN RESEARCH FACILITY OF THE UNITED STATES SPACE STATION**

J. B. CHARLES and M. W. BUNGO (NASA, Johnson Space Center, Houston, TX) Aviation, Space, and Environmental Medicine (ISSN 0095-6562), vol. 57, Oct. 1986, p. 1000-1005. refs

The design of the Space Station's Human Research Facility for the collection of information on the long-time physiological adjustments of humans to space is described. The Space Life Sciences-1 mission will carry a rack-mounted echocardiograph for cardiac imaging, a mass spectrometer for cardiac output and respiratory function assessments at rest and during exercise, and a device to stimulate the carotid sinus baroreceptors and measure the resulting changes in heart rate. I.S.

**N87-13463# Joint Publications Research Service, Arlington, Va. THE EFFECT OF SPACE FLIGHT FACTORS ON THE MUSCLE SYSTEM**

S. S. OGANESYAN *In its* USSR report: Space (JPRS-USP-86-006) p 118-119 12 Nov. 1986 Transl. into ENGLISH from Biologicheskii Zhurnal Armenii (Yerevan, USSR), v. 39, no. 3, Mar. 1986 p 191-196  
Avail: NTIS HC A09/MF A01

Experimental data obtained from studies of various phenotypes of skeletal muscle under conditions of weightlessness are compared with data on the terrestrial modeling of a hypergravitational field and the exclusion of tonic contraction. The mechanism of reverse muscular adaptation to new biomechanical conditions is discussed from the viewpoint of reprogramming the synthesis of individual myofibrillar proteins and their isoforms in relation to the morphological function of muscle fiber. The muscle fiber phenotype is suggested as the limiting factor in adaptive reversible changes. Author

**N87-13924\*** National Aeronautics and Space Administration, Washington, D.C.

**AEROSPACE MEDICINE AND BIOLOGY: A CONTINUING BIBLIOGRAPHY WITH INDEXES (SUPPLEMENT 291)**

Dec. 1986 56 p  
(NASA-SP-7011(291); NAS 1.21:7011(291)) Avail: NTIS HC A04 CSCL 57E

This bibliography lists 131 reports, articles and other documents introduced into the NASA scientific and technical information system in November 1986. Author

**N87-13925#** Wyle Labs., Inc., El Segundo, Calif.

**EXPLORATORY STUDY OF THE POTENTIAL EFFECTS OF EXPOSURE TO SONIC BOOM ON HUMAN HEALTH. VOLUME 1: SONIC BOOM ENVIRONMENT Final Report, Nov. 1984 - May 1986**

C. KAMERMAN, L. SUTHERLAND, and K. PLOTKIN Jun. 1986 159 p

(Contract F33615-81-C-0500)

(AD-A170986; AAMRL-TR-86-020-VOL-1) Avail: NTIS HC A08/MF A01 CSCL 06S

A study has been carried out to investigate possible human health effects caused by exposure of people to sonic boom. The subjects of the study were the residents of the State of Nevada. This state was selected for the study because supersonic military flight operations have been carried out in Nevada, primarily within the boundaries of the Tactical Fighter Weapons Center (TFWC) Range Complex near Las Vegas, longer than in any other area within the United States. This volume presents estimates of sonic boom environments in the State of Nevada during the period from 1969 to 1983. The estimates are based on an extensive analysis of historical records (from Nellis Air Force Base) of supersonic fighter aircraft operations within the TFWC Range Complex, and on available computerized records of supersonic operations of both fighter and SR-71 aircraft within all areas inside the State of Nevada. These latter computerized records are maintained in a Sonic Boom Inquiry Data Base by the Department of Defense, and are intended to include records of all military or DOD-contractor supersonic flight operations throughout the United States. While gaps in this data base may exist, the estimates of sonic boom environments in this report are considered sufficiently reliable to use in searching for a possible link to health effects. GRA

**N87-13926#** Rochester Univ., N. Y. Dept. of Computer Science.

**CONSTRAINTS ON THE COMPUTATION OF RIGID MOTION PARAMETERS FROM RETINAL DISPLACEMENTS**

A. BANDOPADHAY Oct. 1985 79 p

(Contract N00014-82-K-0193)

(AD-A171033; TR-168) Avail: NTIS HC A05/MF A01 CSCL 05J

A mathematical formulation of the Rigid Motion Perception problem is described. The constraints on the parameters of rigid motion (i.e., three-dimensional velocities) obtained from image motion data (two-dimensional projected velocities) are analyzed. A brief survey of related work shows the lacunae in the existing body of research in this area. Uniqueness results and computational algorithms are presented to compute the rigid motion parameters from retinal velocities. The approximations involved in the velocity representation are stated. Algorithms and constraints to permit cooperative computation of motion and shape are described. GRA

**N87-13927#** California Univ., Los Angeles.  
**MEASUREMENT AND MODIFICATION OF SENSORIMOTOR SYSTEM FUNCTION DURING VISUAL-MOTOR PERFORMANCE**  
**Annual Report, 30 Sep. 1984 - 29 Sep. 1985**  
 M. B. STERMAN, T. DUCHENKO, and A. S. HAMEL 5 Jun. 1986 30 p  
 (Contract AF-AFOSR-0335-82)  
 (AD-A171093; AFOSR-86-0556TR) Avail: NTIS HC A03/MF A01 CSCL 05J

The objectives addressed during this phase of our work may be summarized as follows: 1) Complete initial study of sensorimotor and visual cortical EEG correlates of performance in an extended flight simulation task using band-pass analysis. Focus on intrinsic and imposed biological periodicities in these data; 2) Initiate second, more comprehensive study to provide greater resolution of EEG-performance correlates using power-spectral analysis. Focus on problems of situational confusion and fatigue; and 3) Establish program at Edwards Air Force Base for in-flight testing of EEG recording techniques. Collect data for evaluation of EEG characteristics in relation to the dimensions of vigilance and G-induced changes in consciousness. GRA

**N87-13928#** School of Aerospace Medicine, Brooks AFB, Tex.  
**VESTIBULAR SYSTEM PHYSIOLOGY AND SPACE MOTION SICKNESS: AN INTRODUCTION Final Report, 1-31 May 1985**  
 D. L. KELLOGG, JR. Aug. 1986 25 p  
 (AD-A171568; USAFSAM-TR-85-70) Avail: NTIS HC A02/MF A01 CSCL 06S

The purpose of this report is to give the reader a basic understanding of the relationships between the vestibular system and space motion sickness. Space motion sickness is reviewed from a historical perspective. The symptomatology and course are described. The vestibular system anatomy and basic physiology are outlined. Two theories of space motion sickness are presented. Finally, the results of several experimental investigations completed over the last 10 years are examined to expand the reader's understanding of space motion sickness. Author (GRA)

**N87-13929#** Air Force Inst. of Tech., Wright-Patterson AFB, Ohio.  
**PERIOD PREVALENCE OF ACUTE NECK INJURY IN U.S. AIR FORCE PILOTS EXPOSED TO HIGH G FORCES M.S. Thesis**  
 R. D. VANDERBEEK Jun. 1986 39 p  
 (AD-A171970; AFIT/CI/NR-86-167T) Avail: NTIS HC A03/MF A01 CSCL 06E

Neck injury and its sequelae associated with high G forces is an unquantified clinical and epidemiological problem in exposed pilots. There has been a paucity of research in this area. This proposal is a beginning, with a descriptive period prevalence study of acute neck injury in high performance aircraft pilots. A sample of pilots of five different aircraft with varying performance capabilities will be surveyed, utilizing an anonymous questionnaire. Stratified sample data will be analyzed to determine the strength of association of injury prevalence with pilot age, type of G-exposure, and type of aircraft flown. The long-term questions to be addressed are these: (1) For those pilots exposed and having acute injuries, what are the acute and chronic effects on the cervical spine? (2) Are repeated exposures cumulative? (3) Are there degenerative effects such as cervical arthritis? (4) Can the cervical spine tolerate even more high G without deleterious effects? Needed long-term prospective studies will address these questions. This proposal will qualify and quantify the presence of the potential injurious exposure. GRA

**N87-13930#** Army Research Inst. of Environmental Medicine, Natick, Mass.  
**EVALUATION OF A TEMPERATURE ENVIRONMENT HEAT TOLERANCE TEST**  
 L. E. ARMSTRONG, R. W. HUBBARD, J. P. DELUCA, E. CHRISTENSEN, and W. J. KRAEMER Jul. 1986 26 p  
 (AD-A172487; USARIEM-M49/86) Avail: NTIS HC A03/MF A01 CSCL 06S

A temperature environment heat tolerance test (HTT) was formerly reported (Shvartz et al. 1977b) to distinguish heat acclimatized humans from former heat stroke patients. The purpose of this investigation was to evaluate the ability of HTT to measure acute individual changes in the heat tolerance of normal subjects, brought about by classical heat acclimation procedures, thereby assessing the utility and sensitivity of HTT as a heat tolerance screening procedure. We concluded that HTT is not a substitute for classical heat tolerance tests conducted at high ambient temperatures. HTT is apparently most useful in patient or at-risk populations in which preliminary or gross distinctions between heat tolerant and heat intolerant individuals are required. GRA

**N87-13931#** Army Research Inst. of Environmental Medicine, Natick, Mass.  
**COLD ACCLIMATION CAN BE INDUCED IN HUMANS BY REPEATED COLD WATER IMMERSION**  
 A. J. YOUNG, S. R. MUZA, M. N. SAWKA, and K. B. PANDOLF Jul. 1986 20 p  
 (AD-A172509; USARIEM-M52/86) Avail: NTIS HC A02/MF A01 CSCL 06S

The effects of repeated cold water immersion on thermoregulatory responses to cold air were studied in seven males. A cold air stress test (CAST) was performed before and after completion of an acclimation program consisting of daily 90-min cold (18C) water immersion, repeated 5 times/wk for 5 consecutive wk. The CAST consisted of resting 30 min in a comfortable (24C, 30% relative humidity (rh) environment followed by 90 min in cold (5C, 30% rh) air. Pre- and post-acclimation, metabolism (M) increased ( $P < 0.01$ ) by 85% during the first 10 min of CAST and thereafter rose slowly. After acclimation, M was lower ( $P < 0.02$ ) at 10 min of CAST compared with before, but by 30 min M was the same. Therefore, shivering onset may have been delayed following acclimation. After acclimation, rectal temperature ( $T_{sub re}$ ) was lower ( $P < 0.01$ ) before and during CAST, and the drop in  $T_{sub re}$  during CAST was greater ( $p < 0.01$ ) than before. Mean weighted skin temperature ( $T_{sub sk}$ ) was lower ( $p < 0.01$ ) following acclimation than before, and acclimation resulted in a larger ( $P > 0.02$ )  $T_{re}$  to  $T_{sk}$  gradient. Plasma norepinephrine increased during both CAST ( $p < 0.002$ ), but the increase was larger ( $P < 0.004$ ) following acclimation. These findings suggest that repeated cold water immersion stimulates development of true cold acclimation in humans as opposed to habituation. The cold acclimation produced appears to be of the insulative type. GRA

**N87-13932#** Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France). Aerospace Medical Panel.

**BACKACHE AND BACK DISCOMFORT**  
 Loughton, England Jun. 1986 274 p In ENGLISH and FRENCH Meeting held in Pozzuoli, Italy, 8-10 Oct. 1985  
 (AGARD-CP-378; ISBN-92-835-0392-9) Avail: NTIS HC A12/MF A01

Backache and back discomfort are serious economic and operational problems in aerospace environments. The objective of the meeting was to bring military and civilian specialists together to discuss ways and means of alleviating back problems in the cockpit. The papers address both the seating posture and the vibrational environment as contributory factors. Other topics addressed and discussed include the conditions of the spine which predispose individuals to backache, methods for evaluating and predicting back pain, educational programs for the prevention and treatment of recurrent back pain, and strategies for reducing backache in current and advanced cockpit environments.

**N87-13933#** Liverpool Univ. (England). Dept. of Orthopaedic and Accident Surgery.

**EPIDEMIOLOGY OF THE DRIVER'S BACK**

J. D. G. TROUP *In* AGARD Backache and Back Discomfort 4 p Jun. 1986

Avail: NTIS HC A12/MF A01

Back pain is one of the most prevalent of modern symptoms and backache which comes on after sitting is a typical complaint, particularly among drivers. But drivers' backache is not confined to those who seek treatment; it is common throughout the population whether patients or non-patients. Yet both the etiology and the pathomechanism remain unknown. Symptoms are related to the time spent at the wheel thus it may be inferred that they arise from the concomitant postural restraints. But static stresses in the spine arise both from the seated posture itself and from the muscular work of driving; while dynamic stresses, including vibration, arise from the motion of the vehicle. The epidemiological studies so far have not differentiated between the potential causative factors and few, if any, have taken account of other physical activities undertaken by drivers. Author

**N87-13937#** Israeli Air Force Aeromedical Center, Tel Hashomer.

**LOW BACK PAIN AND NARROWED DISC SPACES IN FIGHTER PILOTS**

P. FROMM, S. MARGALIT, and M. GROSS *In* AGARD Backache and Back Discomfort 4 p Jun. 1986

Avail: NTIS HC A12/MF A01

Compressive forces may play a role in the development of disc degeneration. The disc spaces were measured on lateral x-rays of the lumbar spine in fighter pilots with and without a history of sciatica, and compared them to those of asymptomatic transport pilots. An arbitrary cutoff point for normal was defined and the proportion of each group with narrowed disc spaces determined. Fighter pilots with a history of sciatica had a significantly higher proportion of those with narrowed disc spaces than did asymptomatic transport pilots. Fighter pilots without low back pain had an intermediate proportion with narrowed disc spaces. It is concluded that disc degeneration may be accelerated by repeated G(z) forces experienced by pilots of fighter aircraft. Author

**N87-13938#** Institute of Aviation Medicine, Fuerstenfeldbruck (West Germany).

**RELATIONSHIP BETWEEN BACKACHE AND FLYING DUTY IN JET- AND PROP-PILOTS DEMONSTRATED BY A FLYING WING**

K. BURMEISTER and W. K. THOMA *In* AGARD Backache and Back Discomfort 16 p Jun. 1986

Avail: NTIS HC A12/MF A01

A questionnaire assessment was performed in a collective of 88 jet- and prop-pilots. Approximately half of the pilots suffer from backache. A significant connection between the number of flying hours, annual flying stress and sports activities can not be ascertained. The duration of the sitting posture and G-loads are subjectively classified as being the highest body stress, whereas vibrations play a secondary role. The cold pilot's seat in winter and the uncomfortable harness are objects of particular complaints. Concrete facts indicate that in an effort to avoid vertebral pain the seat must be constructed in such a manner as to avoid excessive posterior pelvis tilt. 50% of the pilots questioned are of the opinion that their flying duty causes health damages. Author

**N87-13940#** Institute of Work Physiology, Oslo (Norway).

**MUSCULO-SKELETAL ILLNESSES AMONG WORKERS EXPOSED TO LOW-INTENSITY WORK LOAD OF LONG DURATION**

R. H. WESTGAARD, T. JANSEN, R. BJORKLUND, and M. WAERSTED *In* AGARD Backache and Back Discomfort 9 p Jun. 1986

Avail: NTIS HC A12/MF A01

Low-level, continuous muscle load of long duration has received increasing attention as a potential source of musculo-skeletal injury.

This paper presents evidence which indicates a quantitative relationship between the level of static load on shoulder muscles and the risk of developing musculo-skeletal illnesses in the shoulder and neck. Constrained working postures are probably the most frequent cause of low-level, continuous muscle load, but such loads may also develop for other reasons as illustrated by an example of a probable stress-related development of muscle tension. It is pointed out that aircraft pilots are exposed to a number of factors which can contribute to the development of muscle tension. Low-level muscle tension may therefore be an important health problem for this profession, but this remains to be demonstrated in more specific projects. Author

**N87-13941#** Centre d'Etudes et de Recherches de Medecine Aerospatiale, Paris (France).

**THE BIOMECHANICAL CHARACTERISTICS OF THE SPINAL COLUMN: BIBLIOGRAPHIC REVIEW [ANALYSE BIBLIOGRAPHIQUE DES CARACTERISTIQUES BIOMECHANIQUES DE LA COLONNE VERTEBRALE]**

P. QUANDIEU *In* AGARD Backache and Back Discomfort 28 p Jun. 1986 *In* FRENCH

Avail: NTIS HC A12/MF A01

In order to improve dynamic models of the spinal column, it is necessary, not only to apply to the various coefficients (stiffness, damping and mass) values which are as accurate as possible, but to understand the mechanical behavior of the different biological materials. After a diagrammatic review of the anatomy of the vertebral unit, a bibliographic survey of references addressing the mechanical characteristics of the disk, the ligaments, and the vertebral body is presented. Generally accepted values of creep, relaxation and intranuclear compression, obtained during tests of flexion, extension, lateral inflexion, torsion, and disk shearing are discussed. Parameter values for ligaments are likewise addressed. Data obtained by the propagation of vibrational waves within the column are presented along with an example kinematic study. M.G.

**N87-13942#** Paris V Univ. (France).

**AUTOMATIC RESEARCH ON OPTIMAL POSTURE [RECHERCHE AUTOMATIQUE DE POSTURE OPTIMALE]**

A. M. COBLENTZ, J. F. COBLENTZ, P. GUENEAU, and N. BONJOUR *In* AGARD Backache and Back Discomfort 4 p Jun. 1986 *In* FRENCH

Avail: NTIS HC A12/MF A01

A new perspective on conceptual ergonomics is presented. Specifically, an automatic method for the analysis of optimal posture for a human model in a given environment is described. Algorithms incorporating dynamic programming and artificial intelligence techniques are discussed which model body position and articulation and an ideal reference. M.G.

**N87-13943#** Paris V Univ. (France). Lab. d'Anthropologie Appliquee.

**BIOSTEREOMETRIC STUDY OF THE OUTWARD CURVE OF THE SPINE FOR VARIOUS REFERENCE POSITIONS [ETUDE BVIOSTEREOMETRIQUE DE LA COURBURE EXTERNE DUE RACHIS POUR DIFFERENTES POSITIONS DE REFERENCE]**

A. M. COBLENTZ, J. C. PINEAU, G. IGNAZI, and R. MOLLARD *In* AGARD Backache and Back Discomfort 5 p Jun. 1986 *In* FRENCH

Avail: NTIS HC A12/MF A01

An analysis of the outward curve of the spine was conducted starting with a survey of biostereometric data for a group of male subjects in standing and various sitting positions. The outward curvatures of the spine were determined from the following parameters: radius of the dorsal and lumbar curves, positions of the centers of curves, and localization of the inflexion point. Modifications of the shapes of outward contour were then studied for various sitting positions. The results of these efforts are utilized for three-dimensional modeling of the human body and applied in the analysis of positions in C.A.O. They can likewise contribute to a better understanding of the relations between the forms of the

back in a functional posture and the constrained posture of seated operators. M.G.

**N87-13944#** Finsen Inst., Copenhagen (Denmark).  
**INVESTIGATION OF THE LUMBAR FLEXION OF OFFICE WORKERS**

A. C. MANDAL /in AGARD Backache and Back Discomfort 10 p Jun. 1986  
 Avail: NTIS HC A12/MF A01

Modern furniture in schools, factories and offices is constructed in such a way that no one can use it properly. Each day people sit for many hours hunched over their tables in postures extremely harmful to the back. A considerably better sitting posture can be obtained if the table is constructed higher and if it is tilted about 10 deg. In this way a book or item is brought closer and is at a better angle to the eye. The worst bending of the neck is thus avoided. Furthermore, the seat can, with advantage, be tilted 20 deg forward to reduce the flexion of the lumbar region. By both these means the extra 30 deg flexion, which is the most strenuous part of the flexion, is avoided. This can be demonstrated by means of an automatic camera. To control the flexion of various parts of the body, well defined anatomical points were marked on the skin or on the clothes. Author

**N87-13948#** Laboratoire Central de Biologie Aerospatiale, Paris (France).

**NUMERICAL CONTROL OF A VIBRATING TANK FOR THE STUDY OF TRANSIENT SIGNALS IN BIOMECHANICS [COMMANDE NUMERIQUE DUN POT VIBRANT POUR LETUDE DES SIGNAUX TRANSITOIRES EN BIOMECHANIQUE]**

L. PELLIEUX and B. PIEDECOCQ /in AGARD Backache and Back Discomfort 13 p Jun. 1986 In FRENCH  
 Avail: NTIS HC A12/MF A01

In order to study the propagation of mechanical shock applied to the spinal column of a bioinstrumented primate, a system for the numerical control of the shock signal was developed. When using an implanted accelerometer it is necessary to consider, at the time of implantation, the temporal character of the acceleration selected by the experimenter. The mechanical excitation is effected with the aid of an electrodynamic vibration tank, on which is a fixed seat for the animal. The electric signal transmitted to the vibration tank is numerically calculated by a minicomputer. The system calculates, through filter components, the characteristics of the vibration generating system. It also determines the dynamic characteristics of the biological structure. The technique rests on the hypothesis of linearity and time invariance of the biological structure. However, time invariance is not necessary when the time intervals are short. Likewise, because of the retroactive algorithm used, perfect linearity is not necessary. The method and its limitations are explained and results are reported. M.G.

**N87-13949#** Sunnybrook Medical Centre, Toronto (Ontario).  
**PREDICTION OF LUMBAR SPINAL SEGMENT INSTABILITY BY CENTRODE PATTERNS**

S. D. GERTZBEIN, M. TILE, J. V. SELIGMAN, N. OGSTON, K. H. CHAN, G. KING, R. HOLTBY, and J. D. RUBENSTEIN /in AGARD Backache and Back Discomfort 9 p Jun. 1986  
 Avail: NTIS HC A12/MF A01

The center of rotation defines motion of the lumbar spinal segment; it is an indicator of spinal instability but since the motion segment does not move about a single axis, a locus of instantaneous axes of rotation or a centrode is defined. Centroides in normal cadaveric spines as well as those with degenerative disc disease have been identified using moire techniques as well as by computer analysis of small angles of motion. In this study 47 spines were assessed, 22 of which were evaluated with axial loading. The normal centrode lies within the posterior half of the disc space, averaging 22 mm in 10 specimens. In the earliest stages of degenerative disc disease the centrode lengthens significantly (average 116 mm). Moderate disc disease shifts the centrode inferiorly. Axial loading did not appear to influence the centrode lengths or position. The technique is highly sensitive detecting 94% of the abnormal spines as compared with only

25% detected by means of measuring excessive motion on flexion/extension radiographs. This method is a highly reliable and quantifiable method of detecting early changes in spinal motion in degenerative disc disease prior to the well recognized radiographic abnormalities. Author

**N87-13950#** Uppsala Univ. (Sweden). Dept. of Rehabilitation medicine

**EVALUATION AND PREDICTION OF BACK PAIN DURING MILITARY FIELD SERVICE**

B. NORDGREN, R. SCHELE, and K. LINROTH /in AGARD Backache and Back Discomfort 7 p Jun. 1986  
 Avail: NTIS HC A12/MF A01

Questions regarding back pain in different body positions and earlier sicklisting due to back disorders have been answered by 5,093 men aged 23 to 47 (average age 37) who were about to do military field service. Fifty-three per cent reported that they had had back pain at some time and 14 per cent stated that they had been sick-listed for more than one month in all due to back trouble. A subsample was subjected to a standardized physical examination of the back, average examination time 9 min, and the frequency and location pain, stiffness or other impairments are given. Subjects who experienced back pain during field service and whose military post was physically heavier than their civilian occupation had on an average lower isometric strength in abdominal muscles as well as in back muscles than other subjects. The physical examination of the lumbar spine was more efficient in separating subjects who experienced back pain during military field service, than information on earlier sick-listing due to back trouble and heaviness of the military post as compared to civilian occupation. Author

**N87-13951#** Uppsala Univ. (Sweden). Dept. of Rehabilitation Medicine.

**INDIVIDUAL PREDICTABILITY OF BACK TROUBLE IN 18-YEAR OLD MEN: A PROSPECTIVE STUDY DURING MILITARY SERVICE**

A. L. HELLSING, B. NORDGREN, R. SCHELE, B. AHIBORG, and L. PAULSSON /in AGARD Backache and Back Discomfort 8 p Jun. 1986 Submitted for publication  
 Avail: NTIS HC A12/MF A01

At enlistment 6,824 young men (mean age 18 years) answered a questionnaire concerning back trouble (BT). Out of these 999 passed a standardized physical examination. A follow-up one to four years later during the military service was done, including the same physical examination and questionnaire. The aim was to study the possibility for predicting BT during this time course and the correlations between the variables at enlistment and at discharge. Several significant correlations were found. From the first physical examination, the pain tests (springing test, coin test) correlated with the degree of back trouble at discharge. The questions concerning (1) absence from school or work and (2) effect of BT on every day life before enlistment correlated with the degree of BT at discharge. The highest predictive value, 39%, was shown from the answer to the second question. The answer to the first question showed a predictive value of 25%. None of the examination variables showed predictive value over 20%. Smoking more than 20 cigarettes/day showed a predictive value of 23%. Physical data like height, weight and muscle strength had a predictive value of less than 20%. Author

**N87-13952#** National Defence Medical Centre, Ottawa (Ontario). Physical Therapy Div.

**A REVIEW OF THE NDMC BACK CARE EDUCATION PROGRAMME**

B. P. WARRINGTON-KEARSLEY /in AGARD Backache and Back Discomfort 12 p Jun. 1986  
 Avail: NTIS HC A12/MF A01

The Back Care Education Program (BCEP) at the National Defence Medical Center, directed to the prevention of recurrent low back pain (LBP) is described from its development in 1978 to the present. The course content is also described, and the vicissitudes governing the transformation of the BCEP from a



10-hour five day course conducted twice a month, to the 8.5-hour two day course, to the present 7-hour one day course. Patients were surveyed through initial questionnaires and review questionnaires sent to them 6 months after education. Results show that little demonstrable difference was found between the 5-day and one-day courses. The BCEP has proven very effective in preventing the LBP condition from worsening; less effective in reducing continuous pain; very effective in controlling further attacks of LBP. The BCEP also resulted in 71.5% patients requiring no further treatment and in reducing activity limitation. The BCEP has enabled its clientele to be more responsible for continuing care of their backs by pursuing a regime of regular exercise, activity and behavior modification and postural control. The BCEP has also proved cost effective in increasing the overall effectiveness of military personnel in reducing the number of days lost due to back injury. Author

**N87-13957#** Liverpool Univ. (England). Dept. of Orthopaedic and Accident Surgery.

**MEASUREMENTS OF CHANGE OF STATURE IN THE ASSESSMENT OF STATIC AND DYNAMIC SPINAL LOADING**

J. D. G. TROUP *In* AGARD Backache and Back Discomfort 4 p Jun. 1986

Avail: NTIS HC A12/MF A01

The height of the body in the erect position varies by about 1% during the course of the day. It decreases rapidly on getting up and, depending on the pattern of work and rest, continues to reduce during the day, but recovers overnight. With conventional methods of measuring stature, these changes would go unrecognised. Apparatus has therefore been developed allowing measurement to an accuracy of at least 1 mm. Studies have been made of static loading, lifting, running, in different types of seating and in resting postures. In general, height losses are proportional to the magnitude of lumbosacral compression. In addition, height losses from exercise are related to the perception of the exertion involved; and the gains in height produced in positions of rest are proportional to ratings for relaxation or comfort. For ergonomist, therefore, the method offers a reliable means of assessing the effects of work and recovery on the spine. Author

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**BACKACHE IN AIRCREW**

D. G. READER *In* AGARD Backache and Back Discomfort 6 p Jun. 1986

Avail: NTIS HC A12/MF A01

Aircrew have long complained of backache. The backache is seldom severe, but frequently interferes with flying performance and is very distracting. A survey was conducted among UK aircrew in 1971 which showed that aircrew suffer from backache twice more frequently than groundcrew, pilots suffer more than other aircrew members and that ejection seats caused more backache than other types of seats. The survey also showed that half the aircrew never suffered from backache on the ground. The incidence of backache was high, 13% of pilots suffered on every flight, 22% suffered once a week while 45% suffered once a month. The backache is caused by the sitting position and design of the seat, which leads to loss of the lumbar curve. When the lumbar curve is restored by means of a curved rigid pad applied to the back, 50% of aircrew report that the backache is greatly improved and in 32% of cases completely resolved. A scheme has been underway for some years in the UK to provide lumbar pads for aircrew complaining of backache. The pads are simple and cheap to produce and are easy to use. However, the major disadvantage is that they require a mold for the individual's lumbar curve and then they cannot be used by other aircrew. Aircraft seat designs both for ejection seats and helicopter crew seats now incorporate lumbar support curves to prevent both loss of the lumbar curve and the subsequent backache in aircrews. The incidence of backache in aircraft incorporating these new designs is considerably lower. Author

**N87-13959#** Royal Air Force, Netheravon (England).

**BACK PAIN IN GAZELLE AIRCREW**

M. BRAITHWAITE *In* AGARD Backache and Back Discomfort 8 p Jun. 1986

Avail: NTIS HC A12/MF A01

The prevalence of backache among helicopter aircrew has long been known to be unacceptably high. The introduction of the Gazelle helicopter to UK service has resulted in an apparent increase in this prevalence. This paper is based on a questionnaire issued to Gazelle aircrew serving in Germany during 1981. The aim was to produce numerical evidence of the prevalence of backache in Gazelle aircrew, to delineate the factors responsible in the aircraft and to make recommendations for re-design. The major findings of the survey are that 82% of aircrew complained of Gazelle related backache, the taller pilots being worst affected. Flights lasting longer than one hour gave rise to backache in 70% of the subjects. The seat design features considered responsible were the design of the seat cushion, inadequate lumbar support, routing of the shoulder harness and the angle of seat rake. Since the completion of this survey, a trial of a new Gazelle seat has been carried out. The new design includes an improved seat cushion, inflatable lumbar support, and increased height of the harness take off point from the inertia reel. The results of the initial trial are conclusive in their support for the new seat. These improvements have been incorporated into the design of the Gazelle armoured seat currently under development. Author

**N87-13960#** CAE Electronics Ltd., St. Laurent (Quebec).

**SEAT ISOLATION SYSTEM**

M. VANVLIET, M. MCKINNON, and R. V. KRUK *In* AGARD Backache and Back Discomfort 12 p Jun. 1986

Avail: NTIS HC A12/MF A01

Sustained low-frequency vibrations in helicopters, combined with poor posture imposed by control configuration, can affect the health and performance of aircrew. The attenuation of vibration is recognized as a critical problem in the design of future helicopters, and new (sidearm) control configurations under development may permit better posture. Conventional approaches isolate a pilot with a seat suspension which attenuates the dominant (vertical) axis of vibration. Such seats are typically passive, relying on a system of springs and dampers to attenuate the most critical combinations of expected frequency and g level. The bulk of such seats often precludes retrofitting them to existing air vehicles. Active shock/vibration isolation seats which offer advantages in terms of attenuation and frequency response have been proposed but no successful system has been developed to date. Some flight simulators employ g-seats to simulate g-forces acting on the pilot in high-performance aircraft. The expertise gained in developing, testing, and manufacturing the g-seat provides an ideal basis for developing an active antivibration seat. The frequency range of the g-seat includes the critical band of damaging and fatiguing vibrations in the vertical axis. Laboratory trials have demonstrated that the seat can attenuate the vibration to which the pilot is exposed. Concurrently, development of a displacement multi-axis hand controller for helicopter application is under way. Successful flight tests have been conducted with this unit configured as a side arm controller, permitting pilot to maintain an upright posture. This paper describes an approach and methodology for development of an active antivibration seat within the context of an integrated cockpit seat/control system. The intent is to achieve a high level of crew safety and comfort in concert with improved control performance. Author

**N87-13961#** Joint Publications Research Service, Arlington, Va. **USSR REPORT: SPACE BIOLOGY AND AEROSPACE MEDICINE, VOL. 19, NO. 1, JANUARY - FEBRUARY 1985**

18 Apr. 1985 155 p Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina (Moscow, USSR), v. 19, no. 1, Jan. - Feb. 1985 93 p

(JPRS-USB-85-003) Avail: NTIS HC A08/MF A01

Translations from a Russian bimonthly journal are presented. Representative titles are: Factor analysis of reaction to lower body negative pressure test; Effect of space diet on blood valine content;



Effect of rotation and vibration on human orientation relative to gravity vertical; Amino acid composition of human blood serum during immersion hypokinesia; Skin lesion after exposure to high energy protons and helium ions; and Investigation of growth rate of methane assimilating bacteria in weightlessness.

**N87-13962#** Joint Publications Research Service, Arlington, Va.  
**FACTOR ANALYSIS OF REACTION TO LOWER BODY NEGATIVE PRESSURE TEST ON THE GROUND AND DURING SPACEFLIGHT**

A. D. VOSKRESENSKIY, V. A. DEGTYAREV, V. G. DOROSHEV, and S. L. CHEKANOVA *In its* USSR Report: Space Biology and Aerospace Medicine, Vol. 19, No. 1, January - February 1985 (JPRS-USB-85-003) p 1-3 18 Apr. 1985 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina (Moscow, USSR), v. 19, no. 1, Jan. - Feb. 1985 p 4-5  
 Avail: NTIS HC A08/MF A01

The method of main components was used to examine separately the cosmonauts' responses to lower body negative pressure (LBNP) tests on the ground and in space flight. The factor structures of the ground and flight data did not show significant differences. In both cases the first factor can be termed the factor of venous return and the second, the factor of the cardiac state. The first two factors were responsible for about 60%, and the first three factors for 76 to 78% of data scatter. The observation that the factor structure remains unchanged indicates that LBNP reactions in space flight can be evaluated using the criteria applied on the earth. Author

**N87-13963#** Joint Publications Research Service, Arlington, Va.  
**EFFECT OF SPACEFLIGHT FACTORS ON HORMONAL REGULATION OF FLUID-ELECTROLYTE METABOLISM**

V. Y. SEMENOV *In its* USSR Report: Space Biology and Aerospace Medicine, Vol. 19, No. 1, January - February 1985 (JPRS-USB-85-003) p 4-8 18 Apr. 1985 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina (Moscow, USSR), v. 19, no. 1, Jan. - Feb. 1985 p 6-8  
 Avail: NTIS HC A08/MF A01

The results are presented of examinations of 19 test subjects exposed to head-down tilting at -8 and -15 deg. and of 14 test subjects kept in water immersion for 24 hours. During the first hours of exposure the renal excretion of water and monovalent ions increased. Renin and aldosterone measurements showed that changes in the sodium and potassium excretion were produced by a lower activity of the renin-angiotensin-aldosterone system in the first 1.5 hour of hypokinesia. During immersion the renal excretion of calcium and magnesium also grew, especially in the evening and at night. The parathyroid production and calcium concentration in blood increased, thus augmenting the nephron load. The diurnal rhythms of the renal excretion of potassium, calcium and magnesium remained unchanged and those of water, osmotically active substances and sodium varied. The data obtained indicate significant changes in water-salt metabolism and its regulation within the first hours of head-down tilt and water immersion. Author

**N87-13964#** Joint Publications Research Service, Arlington, Va.  
**EFFECT OF SPACE DIET ON BLOOD VALINE CONTENT**

I. G. POPOV and A. A. LATSKEVICH *In its* USSR Report: Space Biology and Aerospace Medicine, Vol. 19, No. 1, January - February 1985 (JPRS-USB-85-003) p 9-21 18 Apr. 1985 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina (Moscow, USSR), v. 19, no. 1, Jan. - Feb. 1985 p 8-19  
 Avail: NTIS HC A08/MF A01

The content of valine was measured in plasma of 6 healthy male test subjects who were either on a normal or Salyut-5 space diet for 30 days. The measurements were performed with the aid of an amino acid analyzer. Unlike other studies, blood samples were drawn every 5 days. The results suggest that the postflight decrease of the valine content is associated with the food composition. This makes it necessary to improve the amino acid composition of space diets and the technology of their manufacture. The foodstuffs used in the recovery period should be supplemented

with amino acids, particularly valine, to compensate for enhanced anabolic processes. Author

**N87-13966#** Joint Publications Research Service, Arlington, Va.  
**EFFECT OF ROTATION AND VIBRATION ON HUMAN ORIENTATION RELATIVE TO GRAVITY VERTICAL**

O. A. VOROBYEV and V. V. IVANOV *In its* USSR Report: Space Biology and Aerospace Medicine, Vol. 19, No. 1, January - February 1985 (JPRS-USB-85-003) p 30-36 18 Apr. 1985 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina (Moscow, USSR), v. 19, no. 1, Jan. - Feb. 1985 p 24-28  
 Avail: NTIS HC A08/MF A01

Man's ability to get oriented in relation to the gravitational vector was investigated. The test subjects were exposed either to rotation in 1 m arm centrifuge or tilting in a chair. They were simultaneously exposed to total-body vertical vibration of 20 Hz. As the exposure continued, the ratio of the perceived vertical (in the absence of visual keys) and the apparent body position changed significantly. It is concluded that the tests used to evaluate the pilot ability for spatial orientation should include evaluations of the subjective vertical and body position relative to the gravitational vector. The tests should be performed during exposures to simulated dynamic flight factors. Author

**N87-13967#** Joint Publications Research Service, Arlington, Va.  
**RHEOLOGICAL PARAMETERS OF BLOOD AT DIFFERENT LEVELS OF MOTOR ACTIVITY**

A. P. IVANOV, I. B. GONCHAROV, and A. F. DAVYDKIN *In its* USSR Report: Space Biology and Aerospace Medicine, Vol. 19, No. 1, January - February 1985 (JPRS-USB-85-003) p 37-41 18 Apr. 1985 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina (Moscow, USSR), v. 19, no. 1, Jan. - Feb. 1985 p 29-31  
 Avail: NTIS HC A08/MF A01

Blood rheological parameters of essentially healthy people were examined during exercises of a maximal workload and 14 day head-down tilt. The results obtained indicate that in people performing normal and increased motor activity some rheological parameters were different. Changes in the rheological parameters of blood after head-down tilt and exercises with a maximal workload suggest the existence of a blood viscosity threshold above which physical work capacity declines significantly. The capacity can be restored through a correction of blood viscosity in the recovery period. The basic rheological properties of blood can be improved by regular physical training. Author

**N87-13968#** Joint Publications Research Service, Arlington, Va.  
**COMPARATIVE CHARACTERISTICS OF CENTRAL HEMODYNAMICS AND CIRCULATORY REDISTRIBUTION REACTIONS TO ACTIVE AND PASSIVE ORTHOSTATIC TESTS**

G. S. BELKANIYA and V. A. DARTSMELIYA *In its* USSR Report: Space Biology and Aerospace Medicine, Vol. 19, No. 1, January - February 1985 (JPRS-USB-85-003) p 42-52 18 Apr. 1985 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina (Moscow, USSR), v. 19, no. 1, Jan. - Feb. 1985 p 31-39  
 Avail: NTIS HC A08/MF A01

Typological characteristics of central and peripheral (legs and viscera) circulation were identified in 90 clinical healthy people exposed to active and passive orthostatic tests. The following three hemodynamic states were distinguished: hypokinetic, hyperkinetic and intermediate types of circulation. As compared to the passive tests, in the active states cardiac output decreased, leg blood flow increased and viscera blood flow decreased. At the stage of stabilized hemodynamics inotropic cardiac stimulation was predominant during passive orthostatic tests. In the former tests changes in cardiac output and blood redistribution between leg and viscera circulations were more distinct. Mechanisms of hemodynamic changes are discussed. Author

**N87-13969#** Joint Publications Research Service, Arlington, Va.  
**AMINO ACID COMPOSITION OF HUMAN BLOOD SERUM DURING IMMERSION HYPOKINESIA**

A. S. USHAKOV, T. F. VLASOVA, and Y. B. MIROSHNIKOVA  
*In its* USSR Report: Space Biology and Aerospace Medicine, Vol. 19, No. 1, January - February 1985 (JPRS-USB-85-003) p 53-56  
18 Apr. 1985 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina (Moscow, USSR), v. 19, no. 1, Jan. - Feb. 1985 p 39-41

Avail: NTIS HC A08/MF A01

The content of free amino acids was measured in the blood serum of 6 male test subjects exposed to 7 day immersion. During the study the concentration of amino acids decreased in a different manner typical of a stress-effect. The results obtained can be used to develop a system of prevention and therapy of amino acid unbalance.

Author

**N87-13970#** Joint Publications Research Service, Arlington, Va.  
**EFFECT OF LONG-TERM HYPOKINESIA ON BLOOD SERUM LIPID SPECTRUM**

I. I. MEDKOVA, K. V. SMIRNOV, V. P. NAYDINA, B. L. AVETISYANTS, and Y. Y. ZHARKOVSKAYA  
*In its* USSR Report: Space Biology and Aerospace Medicine, Vol. 19, No. 1, January - February 1985 (JPRS-USB-85-003) p 57-62 18 Apr. 1985 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina (Moscow, USSR), v. 19, no. 1, Jan. - Feb. 1985 p 42-45

Avail: NTIS HC A08/MF A01

The effect of 120 day head-down tilt on the lipid spectrum of blood serum was investigated. By thin-layer and gas liquid chromatography lipids (total lipids, phospholipids, cholesterol and its esters, nonesterified fatty acids, triglycerides) and higher fatty acids were identified. It was found that cholesterolemia increased at the expense of the ester bound fraction, phospholipids decreased drastically, the ratio of phospholipids to total cholesterol decreased, and triglyceridemia diminished. Until bed rest day 70 saturated fatty acids were predominant, with linoleic acid being deficient, and thereafter the relative content of unsaturated fatty acids increased. The above changes in the lipid spectrum can be considered as risk factors with respect to preclinical stages of atherosclerosis.

Author

**N87-13971#** Joint Publications Research Service, Arlington, Va.  
**DISTINCTIVE CHANGES IN REGIONAL HEMODYNAMICS AND GAS EXCHANGE IN HEALTHY MAN IN RESPONSE TO MODERATE PHLEBOTOMY AND REINFUSION OF BLOOD AFTER SUBMITTING TO ANTIORTHOSTATIC HYPOKINESIA**

V. Y. VOROBYEV, I. B. GONCHAROV, I. V. KOVACHEVICH, and A. F. DAVYDKIN  
*In its* USSR Report: Space Biology and Aerospace Medicine, Vol. 19, No. 1, January - February 1985 (JPRS-USB-85-003) p 63-67 18 Apr. 1985 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina (Moscow, USSR), v. 19, no. 1, Jan. - Feb. 1985 p 45-48

Avail: NTIS HC A08/MF A01

Nine healthy male test subjects were exposed for 7 days to head-down tilting. Within 2 hours after exposure 500 ml of blood were withdrawn. This reduced pulse blood filling of all lung compartments, particularly the upper ( $P < 0.05$ ) compartments, and decreased slightly finger circulation. The blood losses were then substituted but 2 hours after blood reinfusion the rheographic parameters of pulmonary circulation were still lower than before blood losses. In arterial blood  $pCO_2$  remained lower ( $P < 0.05$ ) and the deficiency of bases increased ( $P < 0.05$ ). It can be concluded that in the above situation blood reinfusion in the amount exceeding blood losses should be viewed adequate. On the basis of the results obtained increased blood content of the lungs in the course of head-down tilt can be interpreted as a reflex mechanism of blood pooling in the body.

Author

**N87-13972#** Joint Publications Research Service, Arlington, Va.  
**ACTIVATION OF LIPID PEROXIDATION IN THE LIVER UNDER HYPOKINETIC CONDITIONS AND ITS PREVENTION WITH ANTIOXIDANTS**

Y. N. PANASYUK and L. N. SKAKUN  
*In its* USSR Report: Space Biology and Aerospace Medicine, Vol. 19, No. 1, January - February 1985 (JPRS-USB-85-003) p 68-74 18 Apr. 1985 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina (Moscow, USSR), v. 19, no. 1, Jan. - Feb. 1985 p 48-52

Avail: NTIS HC A08/MF A01

Experiments on white rats showed that exposure to hypokinesia increased peroxidation of unsaturated fatty acids of lipids of cell membranes, decreased the content of sulfhydryl groups, and increased the content of disulphide groups. This was very marked during the first 4 to 7 days, i.e., during the time of a distinct stress reaction. At later stages the rate of free radical processes decreased slightly. In the recovery period that followed 7-day hypokinesia lipid peroxidation in the rats gradually returned to normal. The initiation of free radical reactions during hypokinesia can be prevented by means of antioxidants (acetate tocopherol, sodium selenite) and syrepar.

Author

**N87-13973#** Joint Publications Research Service, Arlington, Va.  
**SPECIFICITY OF ULTRASTRUCTURAL CHANGES IN RAT MYOCARDIUM SUBMITTED TO HYPOKINESIA AND RADIATION DAMAGE**

V. S. ROMANOV and L. A. BESPALOVA  
*In its* USSR Report: Space Biology and Aerospace Medicine, Vol. 19, No. 1, January - February 1985 (JPRS-USB-85-003) p 75-79 18 Apr. 1985 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina (Moscow, USSR), v. 19, no. 1, Jan. - Feb. 1985 p 53-55

Avail: NTIS HC A08/MF A01

By electron microscopy and morphometry cardiomyocytes of 20 rats gamma-irradiated with a single dose of 180.6 micro Ci/kg and those of 20 rats exposed to hypokinesia for 10 days were examined. Visually the ultrastructural changes of cardiomyocytes were nonspecific. The morphometric examination revealed specific features of ultrastructural rearrangements in the nuclei and mitochondria of cardiomyocytes of rats on day 10 of hypokinesia and irradiation.

Author

**N87-13974#** Joint Publications Research Service, Arlington, Va.  
**LENTICULAR OPACITIES IN MICE EXPOSED TO HELIUM IONS WITH ENERGY OF 4 GEV/NUCLEON AND CO-60 GAMMA RADIATION**

A. N. KABACHENKO and B. S. FEDORENKO  
*In its* USSR Report: Space Biology and Aerospace Medicine, Vol. 19, No. 1, January - February 1985 (JPRS-USB-85-003) p 80-83 18 Apr. 1985 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina (Moscow, USSR), v. 19, no. 1, Jan. - Feb. 1985 p 56-58

Avail: NTIS HC A08/MF A01

The cataractogenic effect of helium ions with the energy 4 GeV/nucleon and Co-60 gamma-radiation was examined. In response to helium irradiation the cataract incidence and maturation rate was higher than in response to gamma-irradiation at the same doses. The relative biological effectiveness (RBE) coefficients of helium ions were calculated from the equally effective doses of reference and helium irradiations. They depended on the exposure duration and amounted to  $1.2 \pm 0.1$ ,  $2.2 \pm 0.1$  and  $2.6 \pm 0.1$  by post-irradiation weeks 20, 30, and 40, respectively.

Author

**N87-13975#** Joint Publications Research Service, Arlington, Va.  
**SKIN LESIONS AFTER EXPOSURE TO HIGH-ENERGY PROTONS AND HELIUM IONS**

N. Y. SAVCHENKO *In its* USSR Report: Space Biology and Aerospace Medicine, Vol. 19, No. 1, January - February 1985 (JPRS-USB-85-003) p 84-88 18 Apr. 1985 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina (Moscow, USSR), v. 19, no. 1, Jan. - Feb. 1985 p 59-62  
 Avail: NTIS HC A08/MF A01

The relative biological effectiveness (RBE) of high energy protons and helium ions was measured with respect to the proliferation rate, cell number of the epidermic basal layer, induction rate of aberrant mitoses, number and type of chromosome aberrations. The animals were examined on postradiation days 1 and 6 (i.e., when the proliferation rate of the first postradiation mitosis was at a maximum). The RBE coefficients of protons and helium ions were unity with respect to the reproductive cell death and cell number of the epidermic basal layer; 1.5 with respect to the formation of multiple cell aberrations; 1.2-1.5 with respect to exchange-type aberrations; and 1.6 with respect to the mitotic index variations. This gives evidence that in response to high energy protons the nuclear apparatus of the cell undergoes profound lesions. Author

**N87-13976#** Joint Publications Research Service, Arlington, Va.  
**EFFECT OF FLIGHT ABOARD COSMOS-1129 BIOSATELLITE ON THYROID HORMONE LEVELS IN RAT BLOOD AND THYROID TISSUE**

R. A. TIGRANYAN, N. F. KALITA, L. MACHO, P. LANGER, and J. KNOPP *In its* USSR Report: Space Biology and Aerospace Medicine, Vol. 19, No. 1, January - February 1985 (JPRS-USB-85-003) p 89-93 18 Apr. 1985 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina (Moscow, USSR), v. 19, no. 1, Jan. - Feb. 1985 p 62-65  
 Avail: NTIS HC A08/MF A01

Thyrotrophia, thyroxine, triiodothyronine, and reverse triiodothyronine were measured in plasma and thyroxine and triiodothyronine in the thyroid gland of the rats flown for 18.5 days onboard Cosmos-1129. Postflight the plasma content of thyrotrophin and triiodothyronine increased and that of thyroxine decreased and the gland content of thyroxine and triiodothyronine diminished. It is postulated that in the flight animals the functional activity of the thyroid gland declined. Author

**N87-14835#** Midwest Research Inst., Kansas City, Mo.  
**EFFECTS OF 60 HZ FIELDS ON HUMAN HEALTH PARAMETERS**  
**Final Report, 9 Sep. 1985 - 14 Mar. 1986**

M. R. COOK, C. M. MARESH, and H. D. COHEN Aug. 1986 61 p Sponsored by Health Effects Research Lab. (PB86-231297; EPA/600/1-86/006) Avail: NTIS HC A04/MF A01 CSCL 06S

Specific results of research on the effects of exposure to 60-Hz electric and magnetic fields have often been contradictory and difficult to replicate. The study reported here used quantitative exercise testing techniques to evaluate whether increases in metabolism, caused by moderate steady-state exercise prior to exposure to real or sham fields, would clarify potential field effects. The feasibility of the methods and procedures used was clearly established. The finding indicated that the physical recovery process following moderate steady-state exercise performed under no exposure conditions, was the same in real and sham fields. Of the variables examined, only cardiac inter-beat interval (IBI) was altered by 2 hr of field exposure. A statistically significant increase in IBI (equivalent to a 3 beat/min decrease in heart rate) was found when subjects were exposed to the real field after sitting quietly prior to exposure. This replicates earlier research, in which IBI was increased following a longer period of field exposure. The results suggest that future studies should examine a broader range of the continuum of human arousal and physiological activation. GRA

**N87-14836#** Army Research Inst. of Environmental Medicine, Natick, Mass.

**INFLUENCE OF A 3.5 DAY FAST ON PHYSICAL PERFORMANCE**  
**RUNNING HEADING: FASTING AND PERFORMANCE**

J. KNAPIK, B. JONES, C. MEREDITH, and W. J. EVANS 1986 30 p (AD-A169597) Avail: NTIS HC A03/MF A01 CSCL 06S

The influence of a 14 h fast or a 3.5 day fast on physical performance was investigated in 8 young men. In both conditions they were tested for isometric strength, isokinetic strength (elbow flexors, 30 degs/sec and 180 degs/sec), anaerobic capacity and aerobic endurance. Anaerobic capacity was evaluated by having subjects perform 50 rapidly repeated isokinetic contractions of the elbow flexors at 180 degs/sec. Aerobic endurance was measured as time to volitional fatigue during a cycle ergometer exercise at 45% VO<sub>2</sub> max. Measures of VO<sub>2</sub>, V sub E, heart rate, and ratings of perceived exertion were obtained prior to and during the cycle exercise. The 3.5 day fast did not influence isometric strength, anaerobic capacity or aerobic endurance, but isokinetic strength was significantly reduced (approx. 10%) at both velocities. VO<sub>2</sub>, V sub E and perceived exertion were not affected by fasting. Fasting significantly increased heart rate during exercise but not at rest. It was concluded that there are minimal impairments in physical performance as a result of a 3.5 day fast provided there is little physical activity during the fasting period. GRA

**N87-14837#** Army Research Inst. of Environmental Medicine, Natick, Mass.

**A COMPUTERIZED SYSTEM FOR MEASURING DETECTION SENSITIVITY OVER THE VISUAL FIELD**

J. L. KOBRICK, A. R. LUSSIER, S. MULLEN, and C. WITT Jun. 1986 22 p (AD-A169600; USARIEM-M-42/86) Avail: NTIS HC A02/MF A01 CSCL 05H

An important aspect of the ongoing visual process is the detection of events both in the central and the peripheral field areas. Although the central line of sight involving the retinal fovea is clearly the locus of greatest visual resolution under photopic viewing conditions, the capability for detection of visual events is also present to a lesser degree in virtually all areas of the visual field. It has been shown that the zone of best overall detection sensitivity is distributed in an ovaloid configuration about the horizontal axis of the visual field, with maximum sensitivity occurring along that axis. A device is described for comprehensively measuring the capability of human operators to detect and react to visual signals occurring at a variety of locations throughout the functional visual field. The system is completely automated and computerized, and provides both documentation files and descriptive graphics of the operator's performance immediately upon completion of testing. Sensitivity of detection can be measured for three stimulus colors (red, yellow, green), in a testing configuration which mimics commonplace surveillance of the ordinary viewing field. An abbreviated listing of the main operating program software is provided. GRA

**N87-14838#** Illinois Univ., Champaign. Cognitive Psychophysiology Lab.

**THE EVENT-RELATED BRAIN POTENTIAL AS AN INDEX OF INFORMATION PROCESSING AND COGNITIVE ACTIVITY: A PROGRAM OF BASIC RESEARCH Annual Progress Report, 1 Jan. 1985 - 31 Dec. 1985**

E. DONCHIN and A. KRAMER 20 Feb. 1986 658 p (Contract F49620-85-C-0041) (AD-A170794; CPL-86-1) Avail: NTIS HC A99/MF A01 CSCL 05J

We review a program of research designed to understand the event-related brain potential (ERP) so that it can be used as a tool in the study of cognitive function and in the assessment of man-machine systems. We have conducted a series of studies on the functional significance of ERPs and have demonstrated the P300 component is related to memory processes. We have used measures of the same component to evaluate workload, to time mental processes, to study reciprocity of processing resources,

and to extend theories of human information processing. We have also made technical advances in the analysis of the distribution of electrical potentials across the scalp. GRA

**N87-14839#** Air Force Inst. of Tech., Wright-Patterson AFB, Ohio.

**THE EFFECTS OF PHYSICAL CONDITIONING ON HEAT TOLERANCE IN CHEMICAL DEFENSE GEAR M.S. Thesis**

M. M. NAUSS Jun. 1986 78 p  
(AD-A170903; AFIT/CI/NR-86-108T) Avail: NTIS HC A05/MF A01 CSCL 06S

Today the threat of chemical warfare is real. The only effective defense is the use of chemical defense gear and gas masks. Since they render chemical warfare gases and liquids impermeable to penetration, they also prohibit sweat evaporation in conditions of thermal stress and thus, contribute to heat illness development. Historically, it has been the hot, humid tropics where United Nation's peacekeeping forces have been called, thus the use of chemical defense gear in these regions is a realistic possibility and heat illness could affect the outcome of any mission carried out there. The human body only operates within a narrow range of core temperatures and heat illness is the result of a breakdown in homeostasis. Adequate hydration, acclimatization to heat, low body weight, young age, low alcohol intake, and physical fitness all contribute to heat tolerance. This proposal attempts to look specifically at the effect of physical conditioning on heat tolerance in chemical defense gear as a possible solution to the heat stress problem. Basic trainee graduates attending technical training schools at Lackland AFB, Texas, will be tested for maximum oxygen uptake (VO<sub>2</sub>max) and heat tolerance time (HTT) in chemical defense gear on bicycle ergometers at Brooks AFB, Texas. Half of these subjects will be physically conditioned for 12 weeks. GRA

**N87-14840#** State Univ. of New York, Buffalo. Hyperbaric Research Lab.

**EFFECTS OF STATIC LUNG LOADING ON CARDIORESPIRATORY FUNCTION IN SUBMERGED EXERCISING SUBJECTS AT DEPTH Final Report, 1 Jan. 1978 - 30 Dec. 1985**

C. E. LUNDGREN 20 Jun. 1986 28 p  
(Contract N00014-78-C-0205)  
(AD-A170914) Avail: NTIS HC A03/MF A01 CSCL 06S

The overall rationale for the work performed under this contract was that an important aspect of man's usefulness under water is the ability to perform physical work. Compared to terrestrial conditions, the diving environment often restricts this ability. The primary limitations to submerged work appear to be cardiorespiratory. This notion is supported by investigations in which exercise at depth was limited by dyspnea, i.e. shortness of breath. Several potentially important factors behind this dyspnea could be envisioned. These factors were: increased respiratory flow resistance due to high gas densities at depth; resistance in the diver's breathing gear; and static lung loading due to depth differences between the diver's chest and his breathing gear. GRA

**N87-14841#** Oak Ridge National Lab., Tenn. Biology Div.  
**RADIATION EFFECTS IN SPACE**

R. J. M. FRY 1986 16 p Presented at the 26th Committee on Space Research Meeting, Toulouse, France, 30 Jun. 1986  
(Contract DE-AC05-84OR-21400)  
(DE86-013257; CONF-8606145-2) Avail: NTIS HC A02/MF A01

The paper discusses the radiation environment in space that astronauts are likely to be exposed to. Emphasis is on proton and HZE particle effects. Recommendations for radiation protection guidelines are presented. DOE

**N87-14842#** University Coll., Cardiff (Wales). Dept. of Applied Mathematics and Astronomy.

**SOME EVIDENCE ON NON-TRANSMISSIBILITY OF ACUTE UPPER RESPIRATORY DISEASE AND RELATED MATTERS**

J. WATKINS, F. HOYLE, and N. C. WICKRAMASINGHE May 1986 49 p

(PREPRINT-115; ETN-86-98361) Avail: NTIS HC A03/MF A01

Acute upper respiratory tract infections account for a significant level of morbidity and sometimes mortality throughout the world. The reported incidence of morbidity ranges from 23 to 62% of the population being affected in any six month period. Such infections are mainly of viral origin, the principal viruses implicated being Influenza A, Respiratory Syncytial Virus, Parainfluenza, Adenovirus, Rhinovirus, Enterovirus, Coxsackie, and Echo virus. These viruses are isolated the world over and show well-defined patterns of global incidence. Despite a coordinated international endeavor directed at tracking down both the temporal and spatial behavior of such viruses, there seems at the present time to be little understanding with regard to their origin and mode of propagation. It is shown here that a wide range of observational data fit well to a model involving atmospheric incidence and transport of these viruses. ESA

**N87-14843#** Southampton Univ. (England). Inst. of Sound and Vibration Research.

**THE EFFECT OF CHANGES IN CEREBROSPINAL FLUID PRESSURE ON THE LABYRINTH IN TERMS OF TYMPANIC MEMBRANE DISPLACEMENT**

J. J. TWEED, R. J. MARCHBANKS, and A. M. MARTIN 1986 81 p

(Contract MRC-G8422151N)

(ISVR-TR-135; ETN-86-98369) Avail: NTIS HC A05/MF A01

It is shown that a pressure change of 30 mm saline in the perilymph fluid can be detected by the tympanic membrane displacement (TMD) measurement system, as a change in the mean volume displacement and maximum inward volume displacement of the tympanic membrane during contraction of the stapedius muscle. The change in perilymphatic pressure, measured in terms of the reflex TMD, faithfully reflects the changes in cerebrospinal fluid (CSF) pressure brought about by controlled changes of posture. A patent cochlear aqueduct is the most probable route for this pressure transfer from the CSF to the perilymph fluid. However, at least 12% of the ears tested show no change in perilymphatic pressure with a change in CSF pressure. The technique can detect high intracochlear fluid pressures in patients with hydrops. The technique may have a significant bearing on the investigation of the time-course of forms of paroxysmal vertigo such as Meniere's Syndrome. ESA

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## BEHAVIORAL SCIENCES

Includes psychological factors; individual and group behavior; crew training and evaluation; and psychiatric research.

**A87-16804**

**SPEECH PROCESSING - THE CROUZET RESEARCH AND DEVELOPMENT PROGRAMME**

P. TARNAUD (Crouzet, S.A., Division Aerospatial, Valence, France) IN: NAECON 1986; Proceedings of the National Aerospace and Electronics Conference, Dayton, OH, May 19-23, 1986. Volume 3. New York, Institute of Electrical and Electronics Engineers, 1986, p. 803-812.

This paper discusses the Crouzet R&D program in the speech-processing field. It first describes the flight tests of the isolated-word recognition technique on a PUMA SA 330 helicopter. The test rig, the objectives, and the main results of those trials are discussed. The second part concerns the connected-word development program. Its main phases: applied research,

ergonomic and functional research, operational-oriented studies and development of airborne systems are detailed. Author

#### A87-16808

##### ESTIMATING PILOT PERFORMANCE DURING CONCEPT DESIGN

V. J. GAWRON, D. TRAVALE (Calspan Corp., Buffalo, NY), and T. J. QUINN (Douglas Aircraft Co., Long Beach, CA) IN: NAECON 1986; Proceedings of the National Aerospace and Electronics Conference, Dayton, OH, May 19-23, 1986. Volume 3. New York, Institute of Electrical and Electronics Engineers, 1986, p. 836-838.

The methodology for penetration evaluation (MPIRE) was used to develop a methodology for evaluating aircrew performance in tactical aircraft crewstations. The MPIRE model was used to generate a complete mission timeline. Account was taken of threat radar detection, geographical surroundings, the command and control structure of the threat systems, and the results obtained with an AI vectoring model that tracked interceptor tracks out to penetrator tracks. A three-value criticality rating scale is described which quantified the effects of failure to perform an assigned task within the allotted time. Mission failures were used to identify task redefinitions and procedures changes which were needed.

M.S.K.

#### A87-16809#

##### COMPARISON OF COGNITIVE LATERALITY WITH FIELD INDEPENDENCE AND THE IMPLICATIONS FOR DISPLAY DESIGN

M. F. KANTER and L. A. SCHREINER (U.S. Navy, Naval Underwater Systems Center, Newport, RI) IN: NAECON 1986; Proceedings of the National Aerospace and Electronics Conference, Dayton, OH, May 19-23, 1986. Volume 3. New York, Institute of Electrical and Electronics Engineers, 1986, p. 839-843. refs

Results are reported from an evaluation of the field-independent/dependent construct (FIDC) and the laterality of function (LOF) concepts in the design of interactive data displays. The FIDC construct posits that it is preferable to use the left side of a display for graphic data and the right side for alphanumeric data to facilitate the cognitive functions of the cranial hemisphere that receives the input. The results show that field-independent individuals are more lateralized than field-dependent persons. Since the subjects were professionals in intellectual fields, the results are of use in designing displays for use by technically-trained individuals.

M.S.K.

#### A87-16810

##### TARGET-PREDICTING CUES AS AIDS TO VISUAL SEARCH OF DISPLAYS

R. K. KNAPP, S. A. LYSLE (Wichita State University, KS), and K. M. DRESEL (Boeing Military Airplane Co., Wichita, KS) IN: NAECON 1986; Proceedings of the National Aerospace and Electronics Conference, Dayton, OH, May 19-23, 1986. Volume 3. New York, Institute of Electrical and Electronics Engineers, 1986, p. 851-854. Research supported by the Boeing Military Airplane Co.

Undergraduates found and reported a digital target among an array of numerals on a color CRT display resembling an artificial horizon. Three groups saw a cue 400 ms ahead of target-noise appearance which predicted, to varied degrees of precision, target location. Such cues significantly quickened target capture compared with a no-cue control, and increasing precision of prediction improved performance. Virtually no errors were made, refuting the certainty of the 'speed vs accuracy tradeoff'. The results supported a serial processing, self-terminating model of visual scanning. A further trend in the data implies that people search visual arrays from the center outward.

Author

#### A87-16817

##### VISUAL EVOKED RESPONSE IN THE PERIPHERY - THE BEGINNINGS OF AN OBJECTIVE MEASURE OF PLL

K. M. KENNER (Synergy, Inc., Human Engineering Div., Dayton, OH), A. M. JUNKER (USAF, Aerospace Medical Research Laboratories, Wright-Patterson AFB, OH), and R. T. GILL (Idaho, University, Moscow) IN: NAECON 1986; Proceedings of the National Aerospace and Electronics Conference, Dayton, OH, May 19-23, 1986. Volume 3. New York, Institute of Electrical and Electronics Engineers, 1986, p. 909-912.

High levels of Gz stress can cause loss of cranial blood supply; the first symptom is Peripheral Light Loss (PLL), leading to loss of consciousness. A technique has been developed to stimulate the periphery of the visual field with sinusoidally modulated light and to detect a Visual Evoked Response (VER) as measured with an EEG. Results have shown coherence to be a sensitive measure of peripheral stimulation.

Author

#### A87-16828

##### A COMBINED INSTRUMENT/PRIVATE PILOT FLIGHT TRAINING PROGRAM

R. H. KAISER, R. A. WEINBERG, T. DAVIS, JR., O. BENN, and H. L. TAYLOR (Illinois, University, Urbana) IN: NAECON 1986; Proceedings of the National Aerospace and Electronics Conference, Dayton, OH, May 19-23, 1986. Volume 3. New York, Institute of Electrical and Electronics Engineers, 1986, p. 1040-1047. Research supported by the Link Foundation and University of Illinois. refs

An experimental program which combines instrument and private-pilot flight instruction, has been conducted using general-aviation simulators and training airplanes. The program consisted of a total of 112.6 hours (34 simulator and 78.6 aircraft) and emphasized the acquisition of instrument flight skills. The ability to control the aircraft during VFR flight was gained during the aircraft flight. Six beginning flight students served as subjects. The effectiveness of the program was evaluated during three intermediate checks and a final check ride conducted by FAA flight examiners. Three of the six subjects demonstrated ability equal to a private pilot with instrument rating.

Author

#### A87-18340

##### THE TRAINING OF PAYLOAD AND MISSION SPECIALISTS TO PERFORM SCIENTIFIC TASKS ON BOARD SPACELAB

D. D. FRIMOUT and O. A. CHIARENZA (ESA, Space Transportation System, Directorate, Paris, France) IN: International Symposium on Space Technology and Science, 14th, Tokyo, Japan, May 27-June 1, 1984, Proceedings. Tokyo, AGNE Publishing, Inc., 1984, p. 1087-1092.

#### A87-19059

##### BASELINE AND COMPARATIVE NEUROPSYCHOLOGICAL DATA ON U.S. ARMY AVIATORS

T. J. GUILMETTE and J. J. TREANOR (Keller Army Hospital, West Point, NY) Aviation, Space, and Environmental Medicine (ISSN 0095-6562), vol. 59, Oct. 1986, p. 950-953. refs

The Wechsler Adult Intelligence Scale-Revised and the Halstead-Reitan Neuropsychological Test Battery were administered to 15 Army aviators and 15 non-aviators, matched for age and education, to identify functional differences between these populations and to begin to establish norms for unimpaired Army aviators. Results were generally nondiscriminatory although Army aviators performed in the high average range on a number of variables. No clinical inferences were drawn from this limited data but utilization of the tests for obtaining normative group and individual baseline data, as well as assisting flight surgeons in assessing intellectual abilities of aviators, appears to have some merit.

Author

**N87-13965#** Joint Publications Research Service, Arlington, Va.  
**OPERATOR'S MENTAL ADAPTATION AND WORK CAPACITY IN SIMULATED WEIGHTLESSNESS**

K. K. IOSELIANI, A. L. NARINSKAYA, and S. R. KHISAMBEYEV  
*In its* USSR Report: Space Biology and Aerospace Medicine, Vol. 19, No. 1, January - February 1985 (JPRS-USB-85-003) p 22-29  
 18 Apr. 1985 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina (Moscow, USSR), v. 19, no. 1, Jan. - Feb. 1985 p 19-24

Avail: NTIS HC A08/MF A01

In two head-down tilt studies of 7 and 8 days in duration, variations in the work capacity of 24 test subjects were examined and the following stages were distinguished: habituation, stable work capacity, and unstable compensation. Among the test subjects two groups were discriminated: those with plastic and those with inert types of adaptation to a changed environment. It is concluded that the plastic-type people can better and faster adapt to head-down tilt and therefore can work more efficiently during an acute stage of adaptation to weightlessness. Author

**N87-13983#** Air Force Inst. of Tech., Wright-Patterson AFB, Ohio.

**THE EFFECTS OF LOCAL EXERTION AND ANTICIPATION ON THE PERFORMANCE OF A DISCRETE SKILL Ph.D. Thesis**

B. JAEGER 1986 143 p

(AD-A170679; AFIT/CI/NR-86-81D) Avail: NTIS HC A07/MF A01 CSDL 05E

A ballistic cranking task was used to study the relationship between local exertion and anticipation on performance. The move was cued by a light sequence similar to a dragstrip start. A subject could predict the move using temporal and spatial cues in the four-light sequence. The sequence was fast or slow and indicated the move would start to the left or right. Twenty percent of the time the lights switched to the opposite row during the sequence. A subject performed this skill after interpolated arm ergometry of 20%, 40%, 60%, or 80% of his arm strength. Dependent measures were absolute error (AE) and constant error (CE) for response timing; error rate; and movement time. Results revealed Precue Speed x Stimulus Continuity interactions for AE, CE, and error rate. Switched-fast trials produced less accurate timing and more errors. Precue Speed caused subjects to respond early for slow sequences and late for fast. Exertion produced only a strong downward trend for movement time. A major finding was that local exertion did not interact with anticipatory variables. The effects of exertion were confined to local physiological processes and did not influence cognitive functions. Additionally, there was no support for an inverted U relationship between exertion and performance. Another important result was that the switched-fast condition produced substantial performance decrements.

Author (GRA)

**N87-13984#** Naval Submarine Medical Center, Groton, Conn.  
**THE EFFECT OF STIMULUS AND TASK VARIABLES ON RESPONSE TIMES TO PICTURES AND WORDS Interim Report**

W. H. ROGERS 27 Jun. 1986 38 p

(AD-A170993; NSMRL-1073) Avail: NTIS HC A03/MF A01 CSDL 05E

Visual display terminals (VDT's) are one of the most important man-machine interfaces in many modern military combat systems, such as sonar and fire-control systems aboard submarines. The complexity of these systems, both in terms of the technological sophistication of the equipment involved and in terms of the problem domain itself, usually results in an overwhelming amount of information being provided to the system operator via VDT's and other interfaces. They provided to the sheer amount of information that must be processed, coupled with frequent time constraints, dictate that operators be able to read and interpret the visual symbols representing information on the VDT's as efficiently as possible. There are many different kinds of visual symbols used on visual displays, including written words, alphabetic abbreviations, numerals, graphic symbols, and pictographs. In some cases, the same information can be depicted by more than one

type of symbol or representation, such as a picture and its written word label to represent and object such as a submarine. If there are differences between different kinds of symbols, in how efficiently they can be processed by operators, then it makes good sense to use those kinds that are most efficiently processed if designers are free to choose among more than one kind of symbol for representation of certain information. GRA

**N87-13985#** Oregon Univ., Eugene. Dept. of Psychology.  
**SEQUENCING AND TIMING IN SKILLED PERCEPTION AND ACTION: AN OVERVIEW Final Report**

S. W. KEELE 1 May 1986 17 p

(Contract N00014-83-K-0601)

(AD-A171861; REPT-86-1-ONR) Avail: NTIS HC A02/MF A01 CSDL 05J

The chapters in this book section are concerned with sequencing and timing in the production and perception of language. Besides giving an overview of each contribution and relating them to some common themes, the present chapter goes a bit further. It is speculated that not only are processes in common to the various manifestations of language-reading, writing, speaking, and listening but there may be even more general processes that encompass other tasks as well. These general processes include a certain mode of sequence representation, one of which is hierarchic in nature, and a general timing mechanism. Hierarchic sequence representation may be the fundamental human achievement in evolution that allows such a remarkable capability to learn new skills and flexibility alter them. Another growing body of literature is beginning to suggest that a timing mechanism, a clock, is in common to diverse motor and perceptual systems. Some of this latter work has been conducted in the present author's laboratory and is summarized in the chapter. Author (GRA)

**N87-13986#** Oregon Univ., Eugene. Dept. of Psychology.  
**COGNITIVE SCIENCE PROGRAM. FORCE CONTROL AND ITS RELATION TO TIMING Final Technical Report**

S. W. KEELE, R. I. IVRY, and R. A. POKORNY 1 May 1986 21 p

(Contract N00014-83-K-0601)

(AD-A171874; TR-86-4-ONR) Avail: NTIS HC A02/MF A01 CSDL 05J

Previous work suggested two general factors of coordination that differentiate people across a variety of motor movements, factors of timing and speed. This study provides comparable evidence for a third general factor of coordination, that of force control. Subjects that exhibit low variability in reproducing a target force with one effector, such as the finger, show low variability with other effectors, foot or forearm. In addition, ability in force control cuts across different force ranges and across situations where force is either the primary goal or of secondary importance. Force records obtained during a periodic tapping task show that, although force control is largely independent of timing, there are some interactions between the two factors. Force variation appears to slightly distort timing in part because large forces speed up implementation of movement, thereby shortening preceding intervals and lengthening following ones, and in part because force variation alters central timing mechanisms. GRA

**N87-13987#** Oregon Univ., Eugene. Dept. of Psychology.  
**SELECTIVE ATTENTION AND COGNITIVE CONTROL Final Report**

M. I. POSNER and D. E. PRESTI 1 May 1986 24 p

(Contract N00014-83-K-0601)

(AD-A171986; TR-86-5-ONR) Avail: NTIS HC A02/MF A01 CSDL 05J

Studies of selective attention suggest a system which operates across modalities and on many forms of internal representation. Complex analysis, even semantic analysis, of sensory input may occur automatically (without attention), but attention controls the locus of action. Investigation of spatial attention within the visual system provides a means to explore the neural systems involved in the control of attention. Author (GRA)

**N87-13988#** Oregon Univ., Eugene. Dept. of Psychology.  
**COGNITIVE SCIENCE PROGRAM. THE CONCEPT OF ENERGY  
 IN PSYCHOLOGICAL THEORY Final Report**  
 M. I. POSNER and M. K. ROTHBART 1 May 1986 26 p  
 (Contract N00014-83-K-0601)  
 (AD-A172085; TR-86-2-ONR) Avail: NTIS HC A03/MF A01  
 CSCL 05J

We seek to understand the integration of computational (information processing) concepts of cognition and energetics (arousal, emotion, temperament). We briefly outline the traditions out of which concepts of cognition and energetics arise. We argue that the integration of these concepts is best done at the level of the component facilitations and inhibitions describing elementary cognitive operations modulated by midbrain arousal systems. We explore this integration for the area of selective attention by defining a hierarchical system in terms of its mental operations and the neural systems supporting them. Author (GRA)

**N87-14844** Defence Research Information Centre, Orpington (England).  
**A MODEL OF TYPING PERFORMANCE WITH RESPECT TO  
 MENTAL LOAD FACTORS**  
 F. M. KUEHN, K. H. SCHMIDT, and W. LAURIG Aug. 1986 17 p  
 (DRIC-T-7770; BR100138; ETN-87-98618) Avail: Issuing Activity

A model for the analysis of computer user behavior in the transcription of given text material or commands is presented. The typing activity is modeled as being partitioned into the perception and encoding of text material; storing this material; and the preparation, execution, and control of the motor output. Experiment subjects were required to read and retype strings. Under the influence of mental load factors (string length and string type) and the subject level of practice two different behavioral strategies in text transcription can be described: a sequential one and a serial one, explained by the model. Results indicate task-dependent limits of the mental capacity of the subjects.

ESA

**N87-14845\*#** National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.  
**APPLICATIONS OF COMPUTER-GRAPHICS ANIMATION FOR  
 MOTION-PERCEPTION RESEARCH**  
 D. R. PROFFITT (Virginia Univ., Charlottesville.) and M. K. KAISER Sep. 1986 14 p  
 (NASA-TM-88335; A-86327; NAS 1.15:88335) Avail: NTIS HC A02/MF A01 CSCL 92B

The advantages and limitations of using computer animated stimuli in studying motion perception are presented and discussed. Most current programs of motion perception research could not be pursued without the use of computer graphics animation. Computer generated displays afford latitudes of freedom and control that are almost impossible to attain through conventional methods. There are, however, limitations to this presentational medium. At present, computer generated displays present simplified approximations of the dynamics in natural events. Very little is known about how the differences between natural events and computer simulations influence perceptual processing. In practice, the differences are assumed to be irrelevant to the questions under study, and that findings with computer generated stimuli will generalize to natural events. Author

**N87-14846\*#** National Aeronautics and Space Administration, Washington, D.C.  
**ON THE PILOT'S BEHAVIOR OF DETECTING A SYSTEM  
 PARAMETER CHANGE**

N. MORIZUMI and H. KIMURA Dec. 1986 27 p Transl. into ENGLISH from Japan Society for Aeronautical and Space Sciences Journal (Japan), v. 33, no. 380, 1985 p 531-539 Transl. by Kanner (Leo) Associates, Redwood City, Calif.  
 (Contract NASW-4005)  
 (NASA-TM-88536; NAS 1.15:88536; ISSN-0021-4663) Avail: NTIS HC A03/MF A01 CSCL 92B

The reaction of a human pilot, engaged in compensatory control, to a sudden change in the controlled element's characteristics is described. Taking the case where the change manifests itself as a variance change of the monitored signal, it is shown that the detection time, defined to be the time elapsed until the pilot detects the change, is related to the monitored signal and its derivative. Then, the detection behavior is modeled by an optimal controller, an optimal estimator, and a variance-ratio test mechanism that is performed for the monitored signal and its derivative. Results of a digital simulation show that the pilot's detection behavior can be well represented by the model proposed here. Author

**N87-14847#** EEG Systems Lab., San Francisco, Calif.  
**NEUROCOGNITIVE PATTERN ANALYSIS OF AUDITORY AND  
 VISUAL INFORMATION Interim Report, 24 Mar. 1984 - 31 Jan. 1986**

A. S. GEVINS 15 Feb. 1986 63 p  
 (Contract F49620-84-K-0008)  
 (AD-A170202; AFOSR-86-0495TR) Avail: NTIS HC A04/MF A01 CSCL 05J

The EEG Systems Laboratory has been actively improving the measurement of neuroelectric substrates of human higher brain functions. The short-term objective has been to use the EEG to predict decrements in performance consequent to attentional lapses or fatigue. The long-term objective is to develop new technologies for enhancing cognitive abilities. The laboratory continues to test subjects in highly controlled paradigms. The paradigms test elementary cognitive and perceptuomotor functions critical for flying high performance aircraft and for performing other tasks with a high cognitive loads. Data are being analyzed from an interdisciplinary, inter-laboratory study of operational fatigue. This unique set of data consists of 57 channels of neurophysiological, physiological and behavioral data recorded from 4 Air Force fighter test pilots performing several cognitive and perceptuomotor tasks specially designed to require a high commitment of attention, memory, judgement and motor coordination. Recordings were made in 3 sessions dealing with task learning, operational fatigue (about 16 hours of continuous performance), and automatization of task performance. GRA

**N87-14848#** Air Force Human Resources Lab., Brooks AFB, Tex.

**UTILIZATION OF PSYCHOMOTOR SCREENING FOR USAF  
 PILOT CANDIDATES: INDEPENDENT AND INTEGRATED  
 SELECTION METHODOLOGIES Final Report, Mar. 1978 - Aug. 1984**

V. P. BORDELON and J. E. KANTOR Jul. 1986 35 p  
 (AD-A170353; AFHRL-TR-86-4) Avail: NTIS HC A03/MF A01 CSCL 05I

Two tests of psychomotor ability (hand-eye coordination) previously developed by the Air Force Human Resources Laboratory were validated against USAF Undergraduate Pilot Training (UPT) performance. Tests which significantly predicted UPT eliminations and differentiated between psychomotor tests were evaluated, including using the tests by themselves as an additional selection gate and combining the scores from the tests with other normally available selection information. The combined approach proved most accurate, and three Integrate Pilot Candidate Selection Models (IPCSMs) were developed using combinations of the psychomotor tests, Air Force Officer Qualifying Test scores, grades from the Flight Screening Program and biographical data.



Comparisons among the IPCSMs were made and recommendations for implementation were presented. GRA

**N87-14849#** Dalhousie Univ., Halifax (Nova Scotia).  
**VISUAL SENSITIVITIES AND DISCRIMINATIONS AND THEIR ROLES IN AVIATION** Interim Report, Oct. 1984 - Sep. 1985

D. REGAN Mar. 1986 42 p  
 (Contract AF-AFOSR-0030-84)  
 (AD-A170418; AFOSR-86-0464TR) Avail: NTIS HC A03/MF A01  
 CSCL 05J

A device has been developed (MIDAPT) that tests a subject's ability to track a target's motion in depth. The test has been encouragingly successful in predicting intersubject differences of pilots' flying performance in high-performance jet aircraft and in simulators. We report evidence that human observers' acute discrimination of differences in size (about 5%) and orientation (about 0.3 deg) is achieved by comparing the outputs of two or more neurons, each of which is sensitive to a rather broad range of sizes and orientations. We suggest that the human visual pathway contains size-opponent and orientation-opponent mechanisms, and that this can explain why subjects easily unconfound orientation, size and contrast in spite of the fact that the firing of cortical neurons is affected by all three parameters. We measured subjects' ability to detect a camouflaged object that was visible only when moving, and compared these data with similar measurements for conventional objects that were brighter than their surroundings. These findings may be relevant to low-level flight, for example in helicopters, where ground features may be virtually indistinguishable except when moving. Monocular ability to judge the direction of motion in depth was investigated by measuring the effect of adaptation to different directions of motion in depth for a target viewed with one eye. GRA

**N87-14850#** Los Alamos National Lab., N. Mex.  
**TRILEVEL INTERACTION DESIGN MODEL FOR PILOT PART-TASK TRAINING**

J. H. ROMAN, R. A. PISTONE, and M. L. STODDARD 1986 6 p  
 Presented at the Annual Meeting of the Human Factors Society, Dayton, Ohio, 30 Sep. 1986  
 (Contract W-7405-ENG-36)  
 (DE86-012428; LA-UR-86-2244; CONF-8609105-1) Avail: NTIS  
 HC A02/MF A01

Development of effective, scenario-driven training exercises requires both an instructional design and a delivery system that match the subject domain and needs of the students. The Training Research Team at Los Alamos National Laboratory conducts research and development of prototype training systems. One of the Team's efforts is a joint research project, supported with funding and behavioral science guidance from the Army Research Institute, to develop a prototype part-task trainer for student helicopter pilots. The Team designed a trilevel interaction model and a Level III interactive videodisc delivery system for this project. The model, founded on instructional and psychological theory, should be transferable to other domains where part-task training is appropriate. DOE

**N87-14851#** Bundesministerium der Verteidigung, Bonn (West Germany).

**INVESTIGATIONS ON INTERACTIONS BETWEEN THE FINE MOTOR CONTROL OF THE HAND AND ACHIEVEMENTS OF ATTENTIVENESS IN AIRMAN TYPICAL PROBLEMS**

E. D. KOZENY Jun. 1985 115 p In GERMAN; ENGLISH summary  
 (REPT-2/85; ETN-86-98214) Avail: NTIS HC A06/MF A01

Correlations between fine motor control of the hand and pilot attentiveness were investigated using psychomotor techniques. By demanding various fine motor control performances, different forms of reaction can be provoked, and in particular cases an additional stress even results in a reduction of the number of errors. The tested fine motor control performances are affected in very different ways by training of the same duration. The tested intellectual performance is not in all areas a linear-function of specific achievements of reaction and control, and the ascertainable

correlation is not equidirectional in all areas of intelligence. These findings underline the importance of not only paying attention to equating the individual starting positions of subjects in aptitude tests fields, but also of taking into account the interdependence of training, motivation, and understanding of instructions. ESA

**N87-14852#** Centre d'Etudes et de Recherches Psychologiques Air, Saint Cyr (France). Base Aerienn 272.

**PILOT APTITUDE EVALUATION SIMULATOR Final Report [LE SIMULATEUR D'EVALUATION DE L'APTITUDE AU PILOTAGE (SEVAP)]**

M. C. VERON, A. D. C. SALLENAVE, S. G. C. JUILIER, S. G. C. BONNEFOUS, and S. C. ARROS 1 Apr. 1986 43 p In FRENCH

(Contract DRET-81-1201)  
 (ETN-86-98433) Avail: NTIS HC A03/MF A01

A psychotechnical evaluation procedure applicable to the initial selection of military pilot candidates is presented. The procedure includes a mobile platform, a pilot's cabin, and a double screen read-out system displaying analog and digital data. The computer program which implements the system is described. The initial evaluation of the selection procedure shows that it is apt to measure the division of attention. The predictive value evaluation must wait for military school results. The developed hardware is available to test other computer programs concerning different pilot psychological aptitude parameters. ESA

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### MAN/SYSTEM TECHNOLOGY AND LIFE SUPPORT

Includes human engineering; biotechnology; and space suits and protective clothing.

**A87-16701**  
**IMPROVING HUMAN-COMPUTER INTERACTION BY LEARNING A MODEL OF USER PREFERENCES**

J. ROACH (Virginia Polytechnic Institute and State University, Blacksburg) and M. WILDING (Texas, University, Austin) IN: The engineering of knowledge-based systems; Proceedings of the Second Conference on Artificial Intelligence Applications, Miami Beach, FL, December 11-13, 1985. Washington, DC, IEEE Computer Society Press, 1985, p. 364-369. refs

This paper reports a system that allows users to train an interface to suit their individual desires and needs. An interface specification editor has been combined with a learning system to create the user trainable interface. As a user indicates desired changes to the interface, the system learns a model of that user's preferences; the model indicates how to adapt the interface to the user. A working user trainable interface is demonstrated in the context of a carrier air traffic control simulation. Author

**A87-16806**  
**VOICE VERSUS MULTIFUNCTION CONTROL WITH DEGRADED MANUAL DEXTERITY**

D. G. CURRY (USAF, Human Resources Laboratory, Williams AFB, AZ), D. W. BIRS (Dayton, University, OH), J. M. REISING, J. P. ZENYUH (USAF, Flight Dynamics Laboratory, Wright-Patterson AFB, OH), and R. P. BATEMAN (Boeing Military Airplane Co., Wichita, KS) IN: NAECON 1986; Proceedings of the National Aerospace and Electronics Conference, Dayton, OH, May 19-23, 1986. Volume 3. New York, Institute of Electrical and Electronics Engineers, 1986, p. 820-825. refs

This paper discusses a study performed in a dynamic cockpit mockup at the USAF Flight Dynamics Laboratory. In it, 18 operational pilots were instructed to perform a series of aircraft subsystem control tasks using both a manually-operated multifunction control and a voice-recognition system, while simultaneously performing a complex loading task. The tests were



performed under two operating conditions: one in which the subject wore standard Air Force flight gear (flight suit, helmet, oxygen mask, and light flying gloves) and a second in which the subject was encumbered with chemical-warfare protective gear (hood, helmet, mask, face plate, and a series of gloves). Author

#### A87-16811

##### DATA ON THE USABILITY OF MICRO SAINT

R. ARCHER, C. DREWS, R. LAUGHERY, S. DAHL (Micro Analysis and Design, Boulder, CO), and F. HEGGE (U.S. Army, Walter Reed Army Institute of Research, Washington, DC) IN: NAECON 1986; Proceedings of the National Aerospace and Electronics Conference, Dayton, OH, May 19-23, 1986. Volume 3. New York, Institute of Electrical and Electronics Engineers, 1986, p. 855-858.

The implementation of a microcomputer version of the simulation software tool SAINT (Systems Analysis of Integrated Networks of Tasks) is described. Micro SAINT was developed to assist in simulating human operator activities. The program considers the task network, a catalog of variables and a function library, continuous variable changes, the simulation scenario, and snapshots of an ongoing simulation. The current version is limited to 250 nodes in the task network. The model was used to examine the workload of pilots flying the LHX helicopter, to model an aircrew training system for AH-1S attack helicopter aircrew, and to simulate the performance of the crew of an M60 tank are outlined.

M.S.K.

#### A87-16812

##### R & D NEEDS IN MIND-MACHINE SYSTEM ENGINEERING COMMON TO MILITARY AND GENERAL AVIATION

M. L. RITCHIE (Ritchie, Inc., Wright State University, Dayton, OH) IN: NAECON 1986; Proceedings of the National Aerospace and Electronics Conference, Dayton, OH, May 19-23, 1986. Volume 3. New York, Institute of Electrical and Electronics Engineers, 1986, p. 877-882. refs

There are possibilities for significant reductions in pilot error in general aviation and military flights during navigation and air traffic control. Flying tasks are described as inherent in the nature of flying or derived from the design of particular hardware or procedures. The large gains may be made in the derived tasks, as the equipment may be redesigned to make radical improvements in task performance. The large gains can be achieved through planned simultaneous changes in pilot tasks and air traffic controller tasks. Pilots and controllers can have much more information available to them, and the flow of information between pilots and controllers can be made much faster and much more reliable. The concept of the Smart Data Link display is described to illustrate the many system interactions required to achieve the simultaneous changes in pilot and controller tasks. Author

#### A87-16813#

##### HUMAN FACTORS RESEARCH AND DEVELOPMENT REQUIREMENTS FOR FUTURE AEROSPACE COCKPIT SYSTEMS

R. J. SCHIFFLER and A. R. PINKUS (USAF, Aeronautical Systems Div., Wright-Patterson AFB, OH) IN: NAECON 1986; Proceedings of the National Aerospace and Electronics Conference, Dayton, OH, May 19-23, 1986. Volume 3. New York, Institute of Electrical and Electronics Engineers, 1986, p. 883-885.

Design requirements and technologies which will heavily influence human factors R&D in cockpit design in the 1990s are discussed. Trends towards integrated displays and controls, increased use of glass or solid-state displays, night vision goggles, laser/nuclear flashblindness protection, and helmet-mounted displays are noted. Pilots will use touch-screens, voice-activated systems and chord keyboards, and expert systems and AI-generated assistance and display control. Man-in-the-loop tests are required before finalizing integrated hardware/software designs. M.S.K.

#### A87-16815

##### A MICRO SAINT SIMULATION ANALYZING OPERATOR WORKLOAD IN A FUTURE ATTACK HELICOPTER

R. LAUGHERY, C. DREWS, R. ARCHER (Micro Analysis and Design, Boulder, CO), and K. KRAMME (Texas Instruments, Inc., Dallas) IN: NAECON 1986; Proceedings of the National Aerospace and Electronics Conference, Dayton, OH, May 19-23, 1986. Volume 3. New York, Institute of Electrical and Electronics Engineers, 1986, p. 896-903.

Task network modeling using the microcomputer-based, menu-driven Micro SAINT language is presented as for quantitatively predicting operator workload in the earliest stages of avionics design. The sequence of tasks performed, i.e., the task network, by the human operator, helicopter and threats are modeled to a desired level of fidelity. Shared variables are identified to account for interactions among the different network segments. Techniques by which Micro SAINT was implemented to evaluate the operator workload in a future attack helicopter are delineated.

M.S.K.

#### A87-16816

##### THE EFFECT OF TASK DIFFICULTY ON THE STEADY STATE VISUAL EVOKED RESPONSE

A. M. JUNKER (USAF, Aerospace Medical Research Laboratories, Wright-Patterson AFB, OH), K. M. KENNER (Synergy, Inc., Human Engineering Div., Dayton, OH), and E. J. CASEY (Illinois, University, Urbana) IN: NAECON 1986; Proceedings of the National Aerospace and Electronics Conference, Dayton, OH, May 19-23, 1986. Volume 3. New York, Institute of Electrical and Electronics Engineers, 1986, p. 905-908. refs

Steady state visual evoked responses to sum-of-sine wave modulated light were measured for subjects as they performed a decision making task. Describing function phase values demonstrated a positive shift under task conditions. The gain of the frequency response exhibited attenuation with increasing task difficulty for half of the subjects. Author

#### A87-16820

##### THE APPLICATION OF PSYCHOLOGICAL SCALING TECHNIQUES IN MODELING EXPERT KNOWLEDGE

J. M. MANHEIMER and T. A. KANARSKI (Lockheed Missiles and Space Co., Inc., Austin, TX) IN: NAECON 1986; Proceedings of the National Aerospace and Electronics Conference, Dayton, OH, May 19-23, 1986. Volume 3. New York, Institute of Electrical and Electronics Engineers, 1986, p. 935-940. refs

Developing models of expert knowledge is a goal of many projects in human factors and artificial intelligence. Unfortunately, conventional methods of knowledge elicitation such as interviewing can be time-consuming and oftentimes inaccurate. This paper identifies psychological techniques that can potentially facilitate the process of knowledge modeling. In particular, multidimensional scaling and additive similarity trees are examined as techniques that can be applied to develop models of expert knowledge in a wide variety of domains. These techniques analyze judgments of psychological distance between items in a domain. In the paper, discussions focus on the psychological rationale underlying the use of multidimensional scaling and additive similarity trees and the results of applying them in ongoing user interface and expert system development projects. Author

#### A87-16821#

##### HUMANE INTELLIGENCE - A HUMAN FACTORS PERSPECTIVE FOR DEVELOPING INTELLIGENT COCKPITS

M. D. MCNEESE (USAF, Human Engineering Div., Wright-Patterson AFB, OH) IN: NAECON 1986; Proceedings of the National Aerospace and Electronics Conference, Dayton, OH, May 19-23, 1986. Volume 3. New York, Institute of Electrical and Electronics Engineers, 1986, p. 941-948. refs

A human factors perspective for creating intelligent cockpits is described and explained. A conceptualized interface among the pilots, mental models, and human information technologies is proposed wherein knowledge concerning human cognition is meshed with the capabilities and limitations of artificial intelligence

(AI). Necessarily, a different way of looking at the pilot's role in the intelligent cockpit is developed. Author

#### A87-16822

##### AIRCREW EMBEDDED TRAINING - A LOGICAL EXTENSION OF CURRENT AND EMERGING TECHNOLOGIES

R. G. HUGHES (McDonnell Douglas Helicopter Co., Simulation Systems Dept., Culver City, CA) IN: NAECON 1986; Proceedings of the National Aerospace and Electronics Conference, Dayton, OH, May 19-23, 1986. Volume 3. New York, Institute of Electrical and Electronics Engineers, 1986, p. 951-959. refs

Embedded Training (ET) continues to be a poorly understood concept, not simply from the standpoint of its mechanization, but also from the standpoint of where it 'fits' into an overall aircrew training system. Current aircrew training resources (e.g. simulators and ranges), including ET, are reviewed with respect to how well each is able to satisfy the requirements of a 'nominal' tactical engagement. Emphasis is placed upon those technologies which must be pursued in order to extend present ET capabilities for application to collective training at the unit level. Author

#### A87-16823

##### HIGH-SPEED FLYOUTS SIMULATIONS IN EMBEDDED TRAINING

A. G. JORDAN (Perceptronics, Inc., Ann Arbor, MI) IN: NAECON 1986; Proceedings of the National Aerospace and Electronics Conference, Dayton, OH, May 19-23, 1986. Volume 3. New York, Institute of Electrical and Electronics Engineers, 1986, p. 963-966.

This paper discusses the utility of high-speed weapon flyout simulations in embedded training (ET) and describes a specific simulation style that has demonstrated capability in an airborne-onboard-computer environment. ET is substantially less expensive to conduct than training exercises requiring multiple live participants such as the TACTS/ACMI training ranges. At the same time, it provides a substantially more realistic environment than classic man-in-the-loop training devices because the trainee is flying the actual aircraft. Advances in onboard computer resources, combined with advanced simulation technology, allow a quantum leap forward in the quality of ET scoring. Author

#### A87-16824#

##### RELATIVE COSTS AND BENEFITS OF AIRCREW TRAINING EQUIPMENT SYSTEMS

R. W. STEPHENSON (USAF, Human Resources Laboratory, Brooks AFB, TX) IN: NAECON 1986; Proceedings of the National Aerospace and Electronics Conference, Dayton, OH, May 19-23, 1986. Volume 3. New York, Institute of Electrical and Electronics Engineers, 1986, p. 976-983. refs

Four alternative aircrew training equipment systems were selected for analysis: a four-cockpit simulator, Air Combat Maneuvering Instrumentation ranges, a pod-mounted recording device for existing aircraft, and equipment-integrated embedded training (ET) systems for new aircraft. The latter two systems both qualify as ET systems. Using expert opinions from a variety of Air Force sources, life-cycle costs were estimated, and qualitative factors were compared. The two ET systems were found to be the least costly alternatives when flying hours were excluded from consideration. Qualitative benefits were found to be overwhelmingly in favor of ET. Author

#### A87-17983

##### THE CONTRIBUTION BY NUCLEAR FISSIONS TO THE RADIATION DOSE ABSORBED BY A TISSUELIKE MATERIAL IRRADIATED BY IRON NUCLEI [VKLAD IADERNYKH RASSHCHEPLENII V POGLOSHCHENNUII DOZU V TKANEEKUIVALENTNOM VESHCHESTVE, OBLUCHENNOM IADRAMI ZHELEZA]

V. A. ANTONCHIK, S. D. BOGDANOV, and N. A. NEFEDOV Leningradskii Politekhnikeskii Institut, Trudy (ISSN 0376-1304), no. 408, 1985, p. 56-59. In Russian. refs

The component makeup of a radiation dose absorbed by a tissue-like material (a spherical sample of 400-micron radius)

irradiated with protons (3.6 GeV), oxygen nuclei (57.6 GeV), and iron nuclei (100 GeV) was analyzed. It is shown that the value of the total absorbed dose in the phantom depends on the mass of the impinging particle. This dependence manifests itself most significantly in the angular characteristics of the absorbed dose. I.S.

#### A87-18127

##### ROBOTICS IN SPACE POWER SYSTEMS ASSEMBLY AND SERVICING

G. R. LUTZ (TRW, Inc., TRW Space and Technology Group, Redondo Beach, CA) IN: IECEC '86; Proceedings of the Twenty-first Intersociety Energy Conversion Engineering Conference, San Diego, CA, August 25-29, 1986. Volume 3. Washington, DC, American Chemical Society, 1986, p. 1768-1775.

Candidate on-orbit electrical power systems were evaluated to assess the level and type of robotic systems which could be advantageously implemented throughout the Space Station growth cycle. Robotics devices for the initial operating configuration of the Space Station are presented as well as future smart robots. Operating and performance characteristics of these devices are discussed and the use of teleoperators as an efficient means of augmenting crew activities is addressed. K.K.

#### A87-18345\* Spar Aerospace Products Ltd., Toronto (Ontario). THE SHUTTLE REMOTE MANIPULATOR SYSTEM AND ITS FLIGHT TESTS

R. RAVINDRAN, S. S. SACHDEV (Spar Aerospace, Ltd., Toronto, Canada), and B. AIKENHEAD (National Research Council of Canada, Space Technology Office, Ottawa, Canada) IN: International Symposium on Space Technology and Science, 14th, Tokyo, Japan, May 27-June 1, 1984, Proceedings. Tokyo, AGNE Publishing, Inc., 1984, p. 1125-1132. Research supported by the National Research Council of Canada and NASA.

The Shuttle Remote Manipulator System (SRMS) has now been flown on seven Space Shuttle Orbiter missions with an eighth mission imminent in June, 1984. This paper describes the design features of the SRMS, a six degree of freedom anthropomorphic man-machine system, and summarizes the results of its Orbital Flight Tests (OFT's) aimed at verifying performance and validating simulation models. In general, behavior and performance of the system has closely followed predictions made by nonreal-time and real-time simulations. Some typical comparisons are presented. Mention is made of operational performance demonstrated on recent flights. Author

#### A87-18400

##### EMU - A HUMAN SPACECRAFT

R. C. WILDE (United Technologies Corp., Hamilton Standard Div., Windsor Locks, CT) IN: International Symposium on Space Technology and Science, 14th, Tokyo, Japan, May 27-June 1, 1984, Proceedings. Tokyo, AGNE Publishing, Inc., 1984, p. 1565-1576. refs

The Shuttle Extravehicular Mobility Unit (EMU), with propulsion from the Manned Maneuvering Unit, is the world's smallest manned spacecraft. This paper describes EMU capabilities and underlying human operator considerations, including bends prevention, suit sizing and task training, and highlights trends in future developments of manned extravehicular activity support systems. The EMU supports useful work in space by Space Shuttle astronauts working in the payload bay or floating nearby, untethered. The EMU provides its human occupant with a habitable environment, life support and communications, and is compatible with a variety of space tools and work aids. Author

**A87-18412****BIOLOGICAL FUNCTIONS TO BE USED IN CELSS**

M. YATAZAWA (Nagoya University, Japan), G. MITARAI (Chukyo University, Toyota, Japan), T. TAKANO (Meijo University, Nagoya, Japan), K. NITTA (Tokyo, University, Japan), and N. TANATSUGU (National Aerospace Laboratory, Chofu, Japan) IN: International Symposium on Space Technology and Science, 14th, Tokyo, Japan, May 27-June 1, 1984, Proceedings . Tokyo, AGNE Publishing, Inc., 1984, p. 1653-1656. refs

The various biological functions to be used in CELSS (Controlled Ecological Life Support System) are discussed. Special attention is paid to the importance of nitrogen fixation by deazotrophs and of sodium extraction by halophytes. Several proposals for earlier investigations are presented for securing ingenuous methods or agents by which gravitational effect can be replaced. Author

**A87-18413****NUTRITION AND FEEDING SYSTEMS IN SPACE**

H. SUZUKI, T. ISHIMA, T. KOBAYASHI, S. HAYAKAWA, M. HORII (National Food Research Institute, Tsukuba, Japan) et al. IN: International Symposium on Space Technology and Science, 14th, Tokyo, Japan, May 27-June 1, 1984, Proceedings . Tokyo, AGNE Publishing, Inc., 1984, p. 1657-1660. refs

Methods for determining the effects of nutrition and feeding systems on the body and mind in space are proposed. It is necessary to establish nutritive evaluation, confirm biomedical and physiological changes induced by space and develop preventive measures, and analyze the effects of cooking and feeding systems on psychological and sociological factors in the Space Station. The effects of the space environment on the cardiovascular, fluid and electrolyte, and musculoskeletal systems are studied. I.F.

**A87-18414****A CONCEPT STUDY ON THE JAPANESE STRAWMAN CELSS EXPERIMENT MODEL**

K. NITTA, M. OGUCHI, K. OTSUBO, A. NAKAJIMA, H. AZUMA (National Aerospace Laboratory, Chofu, Japan) et al. IN: International Symposium on Space Technology and Science, 14th, Tokyo, Japan, May 27-June 1, 1984, Proceedings . Tokyo, AGNE Publishing, Inc., 1984, p. 1661-1668.

In order to prolong the duration of manned missions and to economically conduct their activities in space, the CELSS (Controlled Ecological Life Support System) becomes an essential factor of the future technology to be developed. To develop the CELSS technology, a great deal of information regarding biological metabolism, growth rate, propagation of the plants and animals, and also material recycling from waste to foods is required. Based on these requirements the concept for CELSS experiments is deduced. Author

**A87-18471****HUMAN RELIABILITY WITH HUMAN FACTORS**

B. S. DHILLON (Ottawa, University, Canada) New York, Pergamon Press, 1986, 258 p. refs

Techniques for taking human error into account when evaluating the reliability of technical systems are examined in an introductory test intended for engineering students and practicing engineers. Chapters are devoted to the history and basic terminology of human-reliability studies, the mathematical basis of fundamental concepts, human reliability and human error, human-reliability analysis methods, reliability evaluation of systems with human errors, human factors in maintenance and maintainability, human safety, human-reliability data, human factors in quality control, human factors in design, mathematical models, and applications of human-factors engineering. Diagrams, flow charts, graphs, and problems with solutions are provided. T.K.

**A87-18481****RESEARCH AND DEVELOPMENT OF A SMALL-SIZED SPACE MANIPULATOR**

K. MACHIDA, Y. TODA, T. IWATA, K. NAKAYAMA (Ministry of International Trade and Industry, Electrotechnical Laboratory, Sakura, Japan), K. TSUCHIYA (Mitsubishi Electric Corp., Amagasaki, Japan) et al. IN: Space exploitation and utilization; Proceedings of the Symposium, Honolulu, HI, December 15-19, 1985 . San Diego, CA, Univelt, Inc., 1986, p. 481-494. refs (AAS PAPER 85-660)

Recent space activities require many types of manipulators or robots for assembling and servicing in space, and especially demand small-sized manipulators for dexterous tasks. A 1-meter class articulated manipulator with space environment durability and lightweight has been developed. This paper presents the system design of the manipulator and development efforts of its components. Tribological study of mechanical elements in the vacuum environment, the design of actuator with high torque-to-weight ratio, the control system with the multi-microprocessor and the dynamic control algorithm of the arm are described. A bilateral force-reflecting master-slave control system, using a six dimensional force/torque sensor of the slave arm is also discussed. Author

**A87-18483****PRELIMINARY CONCEPT OF RMS FOR JAPANESE EXPERIMENT MODULE OF THE SPACE STATION**

K. SHIRAKI (National Space Development Agency of Japan, Tokyo), H. MARUMO, Y. SUGASAWA, and S. NISHIDA (Toshiba Corp., Kawasaki, Japan) IN: Space exploitation and utilization; Proceedings of the Symposium, Honolulu, HI, December 15-19, 1985 . San Diego, CA, Univelt, Inc., 1986, p. 517-523. (AAS PAPER 85-662)

A preliminary JEMRMS (Japanese Experiment Module/Remote Manipulator System) concept for inclusion aboard the Space Station is explained. The main RMS tasks are to assist in attaching and detaching the experimental logistics module from the JEM and to handle the Orbital Replacement Unit (ORU), to minimize crew time and hazardous tasks involved in extravehicular activity. The RMS consists of a small, fine-control arm and a main arm with a standard end-effector (SEE). D.H.

**A87-18486****ROBOTICS CONCEPTS FOR THE U.S. SPACE STATION**

D. DORROUGH (Boeing Artificial Intelligence Center, Seattle, WA) IN: Space exploitation and utilization; Proceedings of the Symposium, Honolulu, HI, December 15-19, 1985 . San Diego, CA, Univelt, Inc., 1986, p. 539-568. refs (AAS PAPER 85-666)

The advanced basic concepts of machine intelligence are covered that will be required to produce an operator system interface (OSI) to provide reasonable autonomy on the part of an extravehicular space-station automation. The OSI is considered for a free-flying robot that transits from one task space to another in close proximity to the earth-orbiting Space Station. The OSI would thus perform path planning, track and control, object recognition, fault detection/isolation/correction, and plan modifications in connection with the EV robot operations. To implement such an OSI implies the use of natural languages, voice recognition and synthesis, speech understanding, expert cooperative diagnostic and advisory knowledge systems, and machine learning. The latter technologies are expected to evolve through three distinct phases, where in the first phase the robot is in the primary control loop (human directed), in the second the robot is both primary controller and planner (human monitored), and in the third the robot provides its own goals (human instruction and crisis intervention). Results of Project TAARGET (Transational Assessment of Autonomous Robotic Generational and Evolutionary Technology) suggest that it will not be possible to deploy a fully autonomous EV robot and OSI by the time the Space Station is constructed in orbit. D.H.

**N87-13934#** Rheinische Braunkohlenwerke A.G., Cologne (West Germany). Hauptabteilung Arbeitsmedizin.

**RELATIONSHIPS BETWEEN WHOLE-BODY VIBRATION AND DISORDERS OF THE BACKBONE DIAGNOSED ON OPERATORS OF EARTH-MOVING MACHINERY**

G. ZERLETT /in AGARD Backache and Back Discomfort 5 p Jun. 1986

Avail: NTIS HC A12/MF A01

A study was based on interviewing 352 operators of earth-moving machinery who had been exposed to whole-body vibration for at least 3 years. A further examination dealt with the evaluation of available X-rays showing different parts of the spines of 251 machinery operators who had been exposed to vibration for at least 10 years. The discomfort most often mentioned was impairment of health and well-being during and after the working shift (mentioned by 75% and 59% respectively). Apart from that, the percentage of subjects complaining about spinal discomforts was much higher for the exposed group than for the non-exposed group (70% and 54% respectively). The epidemiologic study resulted in an objective confirmation of the spinal discomforts indicated, 2/3 of which had been related by the operators to the lumbar spine. Of all disorders diagnosed for the operators, the lumbar syndrome accounted for the greatest share by far 81%. In three cases, diagnosis for the operators was avulsion fracture of the spinous process of a vertebral body in the cervical column. The frequency distribution resulting from the radiographic examination of 251 earth-moving machinery operators with at least a 10 years exposure to whole-body vibration showed that morphological changes in the lumbar spine occur earlier and much more frequently than in the case of non-exposed persons.

Author

**N87-13935#** Institut National de Recherche et de Securite pour la Prevention des Accidents du Travail et des Maladies Professionnelles, Vandoeuvre (France).

**THE WORKPLACE VIBRATION ENVIRONMENT OF OFF-ROAD MACHINES**

P. BOULANGER, P. DONATI, J. P. GALMICHE, and L. ROURE /in AGARD Backache and Back Discomfort 11 p Jun. 1986

Avail: NTIS HC A12/MF A01

Measurements made with manufacturers and users enabled I.N.R.S. to evaluate the vibration exposure at the workplace of about 70 different off-road machines presently used in France and the efficiency of machine suspension seats. Measurements were obtained from accelerometers mounted triaxially, placed on the seat pan and on the floor beneath the seat. More than 150 runs were performed to consider a range of typical operating conditions of vehicles studied. According to the standard AFNOR NF E 90-401 the vibration exposures measured on running vehicles fitted with pneumatic tires (dumpers and off-road trucks, tractor scrapers, off-road fork lift trucks, etc...) were greater than those recorded in excavators and back-hoe loaders while digging trenches. The drivers were exposed mainly to vertical vibration unless the vehicles were used for excavating or scraping. In addition, the results show how poor the isolation provided by the seat vertical suspension systems is, especially for those vehicles fitted with pneumatic tires. This proves the necessity to apply seat test code as defined by the French standard AFNOR E 58-074 for off-road machines. The measurements made on the floor beneath the seat generally validate the pertinence of input vibration spectral classes recommended by this standard to test seats in the laboratory although some modifications are suggested. Particularly, it is proposed to include the dumpers and off-road trucks and to define two new classes to take into account horizontal vibrations when necessary.

Author

**N87-13936#** Defence and Civil Inst. of Environmental Medicine, Downsview (Ontario).

**BACK PAIN AND DISCOMFORT RESULTING FROM EXPOSURE TO VIBRATION IN TRACKED ARMoured VEHICLES**

D. BEEVIS and S. E. FORSHAW /in AGARD Backache and Back Discomfort 7 p Jun. 1986

Avail: NTIS HC A12/MF A01

The interrelationship of vehicle ride, operator exposure and back pain was studied using a pool of drivers from the Combat Arms School (CAS), who were required to drive long hours in M113 armored personnel carriers. Among the 28 CAS M113 drivers with back problems, ten had recurrent lower back pain to the extent that time was missed from work. Of the ten, one required surgery during the period of the investigation, and another six, who were free from congenital abnormalities of the spine, were found by X-ray examination to have changes such as degenerative disc disease. A three-aspects approach was taken for the investigation. The first aspect was to review the medical history of the pool drivers for the three years prior to the investigation, and to compare them with those of two other groups of drivers. One group, (RCR drivers), drove the same vehicle but for fewer average hours per week. The other group (Centurion drivers), drove a slower, heavier vehicle for a similar number of hours per week. The second aspect of the study was to review the exposure history of the three groups of drivers. This was done using a modified version of the questionnaire developed by Fitzgerald and Crotty. The third aspect of the study involved the recording and analysis of the ride characteristics of the M113 and the Centurion. Accelerations were measured in three orthogonal axes at the driver's buttocks, as each vehicle was driven at representative speeds over various types of road and terrain. A one-third octave-band analysis of the data was then compared with the exposure limit (EL), the fatigue decreased proficiency boundary (FDP), and the reduced comfort boundary (RC) of ISO 2631. Specific results and data analysis are outlined and it is concluded that the high incidence of back pain observed in the pool driver group was the result of poor posture and exposure to intense levels of vibration and shock for periods exceeding the exposure limits recommended by ISO 2631, and that the incidence of back pain among RCR and Centurion drivers was related to poor driving posture.

M.G.

**N87-13939#** Army Aeromedical Research Lab., Fort Rucker, Ala.

**BACK DISCOMFORT IN US ARMY HELICOPTER AIRCREW MEMBERS**

D. F. SHANAHAN, G. R. MASTROIANNI, and T. E. READING /in AGARD Backache and Back Discomfort 10 p Jun. 1986

Avail: NTIS HC A12/MF A01

The relationship of back discomfort to military helicopter flight operations was studied in this questionnaire survey of 802 U.S. Army helicopter pilots. Of the surveyed population, 584 (72.8%) pilots reported experiencing back discomfort while flying over the last two years. The discomfort generally was described as a dull ache confined to the lower back, with a mean onset time of 88 minutes into a mission. The relationship of reporting the pain to physical characteristics, past medical history, physical activity, and aviation experience is discussed. For over half of the respondents (50.1%), the pain was transient (less than 24 hours duration), resolving rapidly after discontinuing a provoking flight. Nevertheless, there was a significant number of aviators who reported persistent symptoms lasting over 48 hours (14.5%). Possible etiologies of the pain for both groups, as well as potential methods of prevention are discussed.

Author

**N87-13945#** Loughborough Univ. of Technology (England). Dept. of Human Sciences.

**VEHICLE VIBRATION AND BACK PAIN**

J. SANDOVER /in AGARD Backache and Back Discomfort 9 p Jun. 1986

Avail: NTIS HC A12/MF A01

Although it is often suggested that chronic low back pain in professional drivers is related to vibration or posture, we have

only a limited theoretical framework to work with. Well organised, prospective epidemiological studies may demonstrate that chronic low back pain in drivers or pilots is related to high levels of vibration or poor posture. However, they will get us little further without the theoretical base. In this paper, it is assumed that chronic back pain is dependent primarily on disc degeneration and that disc degeneration, in turn, arises from fatigue-induced damage to the vertebral end-plates or to the tissues of the annulus. It will be shown that in either case, time to failure is related to an exponential function of stress such that instantaneous stress maxima are more important than long term (e.g., r.m.s.) stress values. We usually assume the some frequency weighting function is needed to predict, from vehicle vibration, the spinal stress that may lead to malfunction. This function may be based on equal discomfort contours, biomechanics data or a simple model. It is shown that basic assumptions on the effects and on frequency weighting can markedly affect the evaluation of particular vibration environments. Author

**N87-13946#** Technische Univ., Munich (West Germany).  
**IN-VIVO EXPERIMENTS ON THE RESPONSE OF THE HUMAN SPINE TO SINUSOIDAL G SUB Z VIBRATION**

F. W. HAGENA, C. J. WIRTH, J. PIEHLER, W. PLITZ, G. O. HOFMANN, and T. ZWINGERS /in AGARD Backache and Back Discomfort 12 p Jun. 1986  
 Avail: NTIS HC A12/MF A01

The transmissibility of the human spine to vertical G(z)-vibration was up to now investigated mainly by measurements on the body-surface and the head. As it is known that vibration transmission between skin-soft tissue-bone is not linear, we thought it necessary to inert percutaneous K-wires into the spinous process for direct measurements. In 11 healthy subjects at various defined heights of the spine including the head the amplitude ratio was measured to the sacrum and in comparison to the shake table. The tests were performed in standing and sitting position on a shake table with vibration control system. The natural frequency of the spine was confirmed by additional in-vitro tests on isolated lumbar spine segments under special conditions. The human spine acts as a vibration system with three defined areas of resonance. The spinal column causes an adsorption up to the head. Rigid body segments as well as fusional to spinal segments lead to increased strain in neighbouring segments. This was proved by in vivo as well as in vitro investigation. A new set-up for in vitro tests was developed. Author

**N87-13947#** Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France).

**IN VIVO MEASUREMENTS OF VIBRATION TRANSMISSION IN THE HUMAN SPINE Abstract Only**

G. B. J. ANDERSSON, M. M. PANJABI, L. JORNEUS, and E. HULT /in its Backache and Back Discomfort 2 p Jun. 1986  
 Sponsored in part by Swedish Work Environment Fund  
 Avail: NTIS HC A12/MF A01

Although conclusive evidence does not exist, there are many epidemiological surveys suggesting an increase risk of low back pain in persons exposed to vibrations. Theoretical calculations indicate that spinal motion segment components can be stressed by whole body vibration exposure to the degree that fatigue failure can occur. Further, it is also known that vibration can interfere with disc nutrition. Several studies have been published in which the response of the trunk as a whole to vibration was measured. These measurements were usually made with a single uniaxial accelerometer placed on the head of the subject or at some place on the surface of the trunk. The output accelerations have then been related to the input, i.e., vibration transfer functions have been calculated. In this paper, in vivo experiments are discussed in which vibration was measured in the three principal directions in the sagittal plane with accelerometers attached directly to lumbar vertebrae in human volunteers. Author

**N87-13953#** Defence and Civil Inst. of Environmental Medicine, Downsview (Ontario). Biosciences Div.

**POSTURAL FATIGUE AND THE BACKACHE OF HELICOPTER PILOTS**

T. J. BOWDEN /in AGARD Backache and Back Discomfort 10 p Jun. 1986  
 (DCIEM-85-R-30) Avail: NTIS HC A12/MF A01

A review of the literature on the back pain of helicopter pilots suggests that postural fatigue, rather than specific injury to the spine, may be the cause of much of the reported pain. Postural fatigue is defined here as fatigue in specific muscles whose continuous activity is required to maintain a working posture. Descriptions of the back pain of helicopter pilots are compared with those of the phenomenon of postural fatigue. It is significant that there is a strong association between the pilot's back pain and actual flight duty. Biomechanical aspects of the pilot's environment and of tasks within the cockpit are assessed as potential causes of postural fatigue. Both posture and vibration within the cockpit may be possible causes, since both conditions may impose continuous activity on muscles of the lower back. Postural fatigue is a temporary problem, but the causes of postural fatigue, such as sedentary work in awkward postures, are considered by many authors to be related to increased incidence of chronic back pain, back disease and related disability. Repeated exposure to postural fatigue may increase the likelihood of mechanical back injury by reducing the effectiveness of the protection given to the spine by its supporting muscles during tasks involving bending and lifting. Electromyography has been used to index postural fatigue in the laboratory, as well as in the civilian work environment. By objectively defining muscle activity and fatigue, electromyographic methods may allow the objective assessment of different ergonomic proposals to relieve the back pain in helicopter pilots. Author

**N87-13954#** Vermont Univ., Burlington. Dept. of Orthopaedics and Rehabilitation.

**MUSCLE FATIGUE IN STATIC AND VIBRATIONAL SEATING ENVIRONMENTS**

M. H. POPE, D. G. WILDER, and D. D. DONNERMEYER /in AGARD Backache and Back Discomfort 10 p Jun. 1986  
 Avail: NTIS HC A12/MF A01

In order to perform an objective assessment of muscle fatigue in a UH-1-H cockpit seating environment, instrumentation was developed to sense and use as an outcome measure the shift in the center frequency of the electromyographic (EMG) spectrum of the dorsal lumbar musculature. Subjective assessment of fatigue was accomplished by means of a visual analog scale indicating discomfort as a function of duration of exposure to the seated environment. Twenty subjects (10 male and 10 female) were exposed to the same seating environment (in terms of both static posture and vibration exposure) as that experienced by the UH-1-H helicopter pilot. The vibration environment of a UH-1-H helicopter was recorded and reproduced using a servohydraulic vibration simulator. Each exposure lasted two hours. Marginally significant fatigue, as measured by the center frequency shift method, occurred only as a result of the sustained static posture. In contrast, all exposures to this seating environment, in both static and vibration modes, produced significant subjective discomfort in both buttocks and lower back. Thus, the predominant cause of back discomfort and fatigue in this instance appears to be the UH-1-H specific seated posture rather than the UH-1-H specific vibrational environment. Author

**N87-13955#** Laboratoire de Medecine Aerospatiale, Bretigny-sur-Orge (France).

**LOWER BACK PAIN IN HELICOPTER PILOTS: ETIOPATHOLOGICAL FACTORS [LOMBALGIES DES PILOTES D'HELICOPTERES FACTEURS ETIOPATHOGENIQUES]**

J. L. POIRIER, D. LEJEUNE, P. J. METGES, and H. VIEILLEFOND *In* AGARD Backache and Back Discomfort 7 p Jun. 1986 *In* FRENCH

Avail: NTIS HC A12/MF A01

Back pain is presently one of the occupation related hazards of concern to the helicopter pilot. The physiopathogenesis is tied to two factors: posture and vibration. From the postural point of view, our aim was to determine the specific positional characteristics of the spine of a subject seated at the pilot station. Beginning from data obtained with radiography, we have defined rules for the conception and realization of helicopter seats. As concerns mechanical vibration, we conducted a comparative study of the vibration transmissibility for various helicopter seats and seat cushions. It is now possible to contribute improvements to pilot comfort in the postural domain from the point of view of vibration protection. M.G.

**N87-13956#** Tor Vergata Univ., Rome (Italy). Dept. of Electronic Engineering.

**VIBRATION MEASUREMENTS ON HELICOPTER AIRCREW: A NEW APPROACH**

M. A. D. PETTERNELLA, R. BERTI (Aerospace Medicine Center, Rome (Italy).), A. LALA, and R. ANTONINI *In* AGARD Backache and Back Discomfort 12 p Jun. 1986

Avail: NTIS HC A12/MF A01

A method is proposed for obtaining the time-dependent pattern of vibrations transmitted to the seated pilot, by means of a map showing the direction and magnitude of all measured vectors. The pattern easily allows the observer to distinguish between rotational and translational motion. Because the direction of translational motion (or the axis of rotational motion) is not the same in different flight conditions, a suitable reorientation of the frame of reference is required in order to compare the various situations. In this way it is also possible to observe changes of the spin axis or of the direction line, in case of rotational or translation motion respectively. Some results obtained from measurements on board a helicopter at two sites (seat and backrest) are presented. Three orthogonal acceleration vectors are examined. Patterns corresponding to different flight conditions are shown, before and after frame reorientation. The paper closes with a frequency analysis of some of the measurements, comparing amplitudes and phases of the spectral components at the same frequencies, before and after frame reorientation. Author

**N87-13977#** Joint Publications Research Service, Arlington, Va. **PROSPECTS OF USING UNICELLULAR ALGAE PROTEIN IN BIOLOGICAL LIFE-SUPPORT SYSTEMS**

A. A. ANTONYAN, I. A. ABAKUMOVA, G. I. MELESHKO, and T. F. VLASOVA *In its* USSR Report: Space Biology and Aerospace Medicine, Vol. 19, No. 1, January - February 1985 (JPRS-USB-85-003) p 94-99 18 Apr. 1985 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina (Moscow, USSR), v. 19, no. 1, Jan. - Feb. 1985 p 65-69

Avail: NTIS HC A08/MF A01

The concentration, amino acid composition and biological value of proteins of unicellular algae belonging to various taxonomic groups (Chlorella, Chlamydomonas, Spirulina, Euglena) were investigated. With respect to their characteristics, these algae hold promise as components of biological life-support systems (BLSS). Indices characterizing the protein and biomass quality and biological value were calculated. Such indices as A/E (where A is an essential amino acid and E is the sum total of amino acids), E bar/T (where E bar is nitrogen of essential amino acids and T is its sum total), amino acid number, factor of digestibility in vitro were high enough and close to the respective parameters of the reference protein. Animal experiments showed high biological value of the algal biomass and the lack of its toxic or other adverse effects. The data on the quantity and quality of protein from the

unicellular algae are indicative of its high biological value and applicability to BLSS. It is suggested that the differences in the protein composition associated with various algal forms and cultivation conditions can be used to produce balanced diets by varying the portion of each form of the photoautotrophic component of BLSS. Author

**N87-13978#** Joint Publications Research Service, Arlington, Va. **INVESTIGATION OF TOXIC PROPERTIES OF PRESERVATIVES TO BE USED IN WATER RECYCLING SYSTEMS**

G. V. LOBACHEVA, Z. P. PAK, N. M. NAZAROV, and I. V. YAKIMOVA *In its* USSR Report: Space Biology and Aerospace Medicine, Vol. 19, No. 1, January - February 1985 (JPRS-USB-85-003) p 100-104 18 Apr. 1985 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina (Moscow, USSR), v. 19, no. 1, Jan. - Feb. 1985 p 70-72

Avail: NTIS HC A08/MF A01

The comparative toxicity of halogen containing oxidizing agents was investigated with the purpose of their utilization as urine preservatives in water reclamation systems. It was found that the high toxicity of the agents LD sub 50 of agent 1 was 15.7 + or - 1.1 mg/kg and LD sub 50 of agent 2 was 23.0 + or 1.2 mg/kg (when injected i.p. to white mice) was distinctly related to their low pH in water solutions (pH 3 to 4). In neutral solutions the toxicity of agent 1 decreased 35 times and that of agent 2 12 times so that they can be classified as moderately toxic substances. Using an isolated frog heart according to Straub, it was shown that solution neutralization with 20% NaHCO<sub>3</sub> also decreased the toxic effect of the above agents, making them similar to chloramine B, a well known disinfectant. The above agents were found to be rapidly inactivated when stored in low concentrations and to remain highly stable when stored in concentrated solutions. Author

**N87-13979#** Joint Publications Research Service, Arlington, Va. **RELEVANCE OF WATER STRUCTURE TO ASSESSMENT OF QUALITY OF RECYCLED WATER**

V. A. KONDRATYUK *In its* USSR Report: Space Biology and Aerospace Medicine, Vol. 19, No. 1, January - February 1985 (JPRS-USB-85-003) p 105-110 18 Apr. 1985 Transl. into ENGLISH from Kosmicheskaya Biologiya i Aviakosmicheskaya Meditsina (Moscow, USSR), v. 19, no. 1, Jan. - Feb. 1985 p 73-76

Avail: NTIS HC A08/MF A01

Among the physicochemical methods used to measure ion hydration in water solution, the most informative are those employed to evaluate the energetic state of the water molecule (swelling heat, gelatination, UV-spectrophotometry). These data may yield information about the water structure to be used in estimating the quality of potable water of different origin. IR-spectrophotometry and x-ray diffraction analysis are of lower informativity. A certain correlation has been found between the structure and biological action of water. Author

**N87-13989\*#** Hamilton Standard, Hartford, Conn. Space and Sea Systems Dept.

**DEVELOPMENT OF A PRE-PROTOTYPE POWER ASSISTED GLOVE END EFFECTOR FOR EXTRAVEHICULAR ACTIVITY Final Report**

1986 26 p

(Contract NAS9-17020)

(NASA-CR-171940; NAS 1.26:171940; SVHSER-10630) Avail: NTIS HC A03/MF A01 CSCL 05H

The purpose of this program was to develop an EVA power tool which is capable of performing a variety of functions while at the same time increasing the EVA crewmember's effectiveness by reducing hand fatigue associated with gripping tools through a pressurized EMU glove. The Power Assisted Glove End Effector (PAGE) preprototype hardware met or exceeded all of its technical requirements and has incorporated acoustic feedback to allow the EVA crewmember to monitor motor loading and speed. If this tool is to be developed for flight use, several issues need to be addressed. These issues are listed. Author



**N87-13990\*#** Eloret Corp., Sunnyvale, Calif.

**BALLISTIC LIMIT OF 6061 T6 ALUMINUM AND THREAT TO SURFACE COATINGS FOR USE WITH ORBITING SPACE STATION SPACE SUIT MATERIALS**

D. FISH 21 Nov. 1986 29 p

(Contract NCC2-347)

(NASA-CR-179884; NAS 1.26:179884) Avail: NTIS HC A03/MF A01 CSCL 06K

In recent years orbiting satellites, spent components, collisions and explosions have populated the near earth orbit with debris potentially more hazardous than the average meteoroid debris. This new debris has an average density of aluminum (2.78 g/cc) and an average encounter velocity of 10 km/sec. The space station will require many hours of work in this environment and there is concern over hazard to the assembly personnel. A proposed hard suit design utilizes 6061-T6 Aluminum for most of its exposed area. The aluminum surface will be treated for thermal and radiation control. The basic thickness of this suit will be on the order of 1.78 mm (0.070 inches). The selection of 6061-T6 Aluminum for space suits for use on the space station would appear to be worthwhile. The relatively ductile behavior of 6061-T6 aluminum is better than a choice of a more brittle material. F.M.R.

**N87-13991\*#** Massachusetts Inst. of Tech., Cambridge. Dept. of Applied Biological Sciences.

**UTILIZATION OF NON-CONVENTIONAL SYSTEMS FOR CONVERSION OF BIOMASS TO FOOD COMPONENTS: RECOVERY OPTIMIZATION AND CHARACTERIZATIONS OF ALGAL PROTEINS AND LIPIDS Status Report, Mar. 1985 - Jun. 1986**

M. KAREL and Z. NAKHOST Jul. 1986 28 p

(Contract NCC2-231)

(NASA-CR-179756; NAS 1.26:179756) Avail: NTIS HC A03/MF A01 CSCL 95D

Protein isolate obtained from green algae (*Scenedesmus obliquus*) cultivated under controlled conditions was characterized. Molecular weight determination of fractionated algal proteins using SDS-polyacrylamide gel electrophoresis revealed a wide spectrum of molecular weights ranging from 15,000 to 220,000. Isoelectric points of dissociated proteins were in the range of 3.95 to 6.20. Amino acid composition of protein isolate compared favorably with FAO standards. High content of essential amino acids leucine, valine, phenylalanine and lysine makes algal protein isolate a high quality component of closed environment life support system (CELSS) diets. To optimize the removal of algal lipids and pigments supercritical carbon dioxide extraction (with and without ethanol as a co-solvent) was used. Addition of ethanol to supercritical CO<sub>2</sub> resulted in more efficient removal of algal lipids and produced protein isolate with a good yield and protein recovery. The protein isolate extracted by the above mixture had an improved water solubility. Author

**N87-13992#** Army Research Inst. of Environmental Medicine, Natick, Mass.

**THERMAL RESPONSES OF TANK CREWMAN OPERATING WITH MICROCLIMATE COOLING UNDER SIMULATED NBC CONDITIONS IN THE DESERT AND TROPICS**

B. S. CADARETTE, N. A. PIMENTAL, C. A. LEVELL, J. E. BOGART, and M. N. SAWKA Feb. 1986 32 p

(AD-A169269; USARIEM-T7/86) Avail: NTIS HC A03/MF A01 CSCL 06Q

As part of the overall field testing of the M1E1 tank, evaluations were made of the thermal responses of crewmen wearing an air-cooled system (vest and ventilated facepiece) designed by the U.S. Army Natick Research, Development and Engineering Center (USANRDEC). Crewmen performed continuous operations for up to 12 hours in MOPP level 4 over the CVC uniform. Testing took place in both desert (Yuma Proving Grounds, AZ) and tropic (Tropic Test Center, Republic of Panama) environments. During the two desert tests, ambient temperature ranged from 23-37 C and from 26-38 C with relative humidities from 20-60%, and 22-64%, respectively. During the first desert test, the equipment used to cool the air to the USANRDEC system was insufficient. Regardless,

when the test was aborted after 7.5 hours, the greatest core temperature (T<sub>sub re</sub>) increase was 0.2 C. During the second desert test, the mean increase in T<sub>sub re</sub> was 0.1 C over 12 hours. The tropic test was carried out with ambient conditions of 27-36 C db, 40-81% rh. The crewmen exhibited a decrease in T<sub>sub re</sub> during the first hour in the tank and then a mean increase of 0.5 C over the next 11 hours. This was with the M1E1's air conditioning system providing air not cooled to specifications. These results indicate that the air-cooled system designed by USANRDEC increases the capabilities of tank crewmen operating in MOPP level 4 in both desert and tropic environments. GRA

**N87-13993#** Naval Air Development Center, Warminster, Pa. Aircraft and Crew Systems Technology Directorate.

**ANTI-G SUIT PROTECTION AND BODY POSITION Interim Report**

E. HENDLER, L. HREBIEN, and P. E. WHITLEY Apr. 1986 17 p

(AD-A169545; NADC-86067-60) Avail: NTIS HC A02/MF A01 CSCL 06Q

Specifications for the anti-G valve dealing with outlet pressures to be furnished during sustained accelerations (Gz) relate only to the usual upright seated body position assumed by pilots flying conventionally configured aircraft. For modern high-performance fighter and attack aircraft, it has been proposed that the pilots be supinated in order to better tolerate the high G loads these aircraft are capable of generating. The study to be described was the second in a series conducted for the purpose of determining the effects upon relaxed G tolerance of some G protective techniques, including use of the AGS and supination. Six relaxed, G-trained subjects were exposed on the NAVAIRDEVCE Dynamic Flight Simulator (DFS) to increasing G pulses in order to measure their G tolerance. Acceleration profiles consisted of haversine-shaped onsets and offsets lasting 2 or 8 s, with 15 s plateaus interposed. When the pressure delivered to anti-G suit (AGS) bladders was reduced in accordance with the calculated reduction in the height of the vertical hydrostatic blood column, brought about by supinating relaxed subjects, G protection provided by the AGS was greater than that provided when the relaxed subjects were seated upright. GRA

**N87-13994#** SEACO, Inc., Kailua, Hawaii.

**PERCEPTION OF DEPTH WITH STEREOSCOPIC COMBAT DISPLAYS Final Report, Dec. 1983 - Aug. 1984**

R. Y. NISHIO Mar. 1986 126 p

(Contract N00123-82-D-0059)

(AD-A170348; NOSCR-348) Avail: NTIS HC A07/MF A01 CSCL 05J

A series of four experiments was conducted to investigate the independent and interactive effects of three video system parameters on the scaling of depth intervals viewed through stereoscopic (stereo) combat display systems. Experiment One investigated the effects of interaxial separation and lens magnification. Experiments Two investigated the effects of camera convergence. Experiments Three and Four partially replicated the video system used in Experiment One under more complex scene conditions. For all experiments, ocular fatigue induced by various combinations of system parameters was also measured. For Experiments One, Two, and Three, stereoscopic imagery produced depth interval estimates which were superior to those found under monoscopic viewing conditions. In addition, increasing camera separation and thereby increasing retinal disparities beyond natural stereo values improved depth interval estimation. Camera convergence exerted a significant effect with convergence in front of the area of interest providing greatest accuracy. Lens magnification was not found to exert a significant influence on depth interval estimation. No evidence of ocular fatigue was found under any conditions tested in any of the experiments.

Author (GRA)

**N87-13995#** Department of the Navy, Washington, D. C.  
**LASER EYE PROTECTION VISOR USING MULTIPLE HOLOGRAMS Patent**

G. E. MOSS, inventor (to Navy) 22 Jul. 1986 5 p Supersedes AD-D010196

(AD-D012455; US-PATENT-4,601,533;  
 US-PATENT-APPL-SN-437729; US-PATENT-CLASS-350-3.7)

Avail: US Patent and Trademark Office CSCL 06Q

This patent discloses a diffractive radiation shield for protecting eyes and radiation sensitive devices from laser radiation. The shield utilizes one or more holograms disposed on transparent substrates. These holograms consist of spherical holographic fringes recorded in a dischromated gel with which the substrates are coated. The holographic fringe reflect laser radiation which is normal to their respective surfaces. Reflectivity is maximized for a particular wavelength by proper selection of the fringe spacing. The shield may be configured as a visor for an aviator's helmet. GRA

**N87-13996#** Carnegie-Mellon Univ., Pittsburgh, Pa. Robotics Inst.

**ANALYSIS OF HUMAN COMMUNICATION DURING ASSEMBLY TASKS Interim Report**

K. S. BARBER and G. J. AGIN Jun. 1986 49 p  
 (AD-A171843; CMU-RI-TR-86-13) Avail: NTIS HC A03/MF A01 CSCL 05H

This paper studies human-to-human interaction in an attempt to shed some light on the kinds of human-to-machine interaction that will be necessary for intelligent robot learning of assembly tasks. Experiments were performed in which an expert guided an apprentice through a complex assembly task using spoken language but no visual communication. An analysis of the dialog reveals that certain protocols and conventions facilitate communication, and that communication breaks down when these protocols are not observed. Five types of protocols were observed: focusing, validators, referencing, descriptors and dialog structure. The implications of these results for human-robot communication are discussed. GRA

**N87-13997#** Army Research Inst. of Environmental Medicine, Natick, Mass.

**EXERCISE ENDURANCE TIME AS A FUNCTION OF PERCENT MAXIMAL POWER PRODUCTION**

E. A. HARMAN, H. G. KNUTTGEN, P. N. FRYKMAN, and J. F. PATTON Jul. 1986 34 p  
 (AD-A172475; USARIEM-M-50/86) Avail: NTIS HC A03/MF A01 CSCL 06N

To develop and statistically validate a mathematical model of the relationship between endurance time (T) and power production, 15 male subjects were first tested for maximal power on an instrumented cycle ergometer at 60 RPM. On subsequent days they were tested for T at various percentages of maximal power. Curves of T as a function of percent maximal power were curvilinear, and could be made to overlap among subjects by individual abscissa scaling, which resulted in the appearance of horizontal stretching or compression of the curves. The degree of stretching-compression was defined by a statistically obtained scaling factor (F) which served to quantify each subject's endurance ability at fractions of maximal power. F was used to transform percent of maximal power to a scaled power variable ( $P_{sub\ sc}$ ). A curve of the form  $T = a \text{ times } (P_{sub\ sc})^b$  to the bth power was developed on 10 of the subjects and validated on the remaining five. Correlation between predicted and actual T was 0.976 for the fitting group and 0.980 for the validation group. A maximal power test and a single endurance test at 40 to 50% of maximal power were found to establish individual endurance-power curves fairly well, with a correlation of 0.828 between actual and predicted T. The combination of F and maximal power for a given physical activity provide a useful profile of an individual's ability to perform at constant exercise intensity. GRA

**N87-13998#** Fraunhofer-Inst. fuer Arbeitswirtschaft und Organisation, Stuttgart (West Germany).

**DEVELOPMENT OF ERGONOMICALLY DESIGNED CONTROL ELEMENTS Final Report, Dec. 1982**

P. KERN, W. MUNTZINGER, and J. J. SOLF Bonn, West Germany Bundesministerium fuer Forschung und Technologie Jan. 1986 199 p In GERMAN; ENGLISH summary Sponsored by Bundesministerium fuer Forschung und Technologie (BMFT-FB-HA-86-002; ISSN-0171-7618; ETN-86-98197) Avail: NTIS HC A09/MF A01 Fachinformationszentrum, Karlsruhe, West Germany DM 36.50

Rotatory continuously operated control elements for specific work situations, including anatomical, anthropometrical and physiological boundary conditions of the hand-arm system were developed. The alternatives were evaluated using performance, stress, and strain parameters. For different requirements of the control task, alternatives for shape and dimension were suggested, for one and two-handed operation, which serve as the basis for the development of control standards. For the definition of the shape and dimension of control elements, a wide variety of coupling conditions must be considered, depending on the position of the control elements. Recesses in the contact elements do not offer any advantages. Fine profiles are advantageous with respect to large-torque applications and unfavorable environmental conditions such as heavy dirt. Control elements coated with pressure-anthropomorphic material are recommended. ESA

**N87-14853** Civil Aviation Authority, London (England).

**HELICOPTER PASSENGER WEIGH SURVEY, CONDUCTED AT ABERDEEN AIRPORT, NOVEMBER 1984**

Feb. 1985 11 p  
 (CAA-PAPER-85005; ISBN-0-86039-235-X; ETN-87-98599) Avail: Issuing Activity

Over 1000 passengers flying to offshore platforms were weighed for use in drawing up operational guidelines for civil aviation. Average weight is 79.4 kg, plus 2.2 kg with survival suit. ESA

**N87-14854#** Person-System Integration, Inc., Alexandria, Va.  
**EXPERT SYSTEM DESIGN AID FOR APPLICATIONS OF HUMAN FACTORS IN ROBOTICS Final Report, 1 Sep. 1985 - 1 Apr. 1986**

J. MCGUINNESS, J. WAGNER, J. M. NICHOLS, and C. J. RHOADS 12 Jun. 1986 242 p  
 (Contract N60921-85-C-0252)  
 (AD-A169632; PSI-K31-TR885) Avail: NTIS HC A11/MF A01 CSCL 09B

Research was performed to provide the groundwork for an Expert System that will function as a design aid for robotics applications. The Expert System is entitled Human Factors-Robotics Expert System (HF-ROBOTEX). This effort involved a number of interrelated steps including an examination of state-of-the-art technology in the fields of Expert Systems, Human Factors, and Robotics. A design specification was written incorporating the knowledge gained to guide the development of the Expert System. HF-ROBOTEX specification employs a modular design using a microcomputer-based system technology. It consists of three elements: a user interface, a knowledge base, and an inference driver. The knowledge base is designed to incorporate the knowledge of experts and selected sections of current Human Factors Guidebooks/Handbooks. The selection of data sources was guided by a literature review, by inputs from Human Factors Engineers, as well as by professionals involved in the application of robotics and Expert Systems. The inference driver uses rules of reasoning (i.e., heuristics) to access, as well as interpret information in the knowledge base and generate conclusions. GRA



**N87-14855#** School of Aerospace Medicine, Brooks AFB, Tex.  
**ANTHROPOMETRY HANDBOOK Final Report, Sep. 1982 - Mar. 1984**

P. H. GILL Feb. 1986 109 p  
 (AD-A170298; USAFSAM-TR-85-108) Avail: NTIS HC A06/MF A01 CSCL 06N

This report details the rationale (techniques and equipment used, and specific body measurements recommended) for the use of an anthropometry laboratory and body size measuring equipment which have been constructed to support the development of a comprehensive Cockpit and Equipment Integration Laboratory.

GRA

**N87-14856#** Aeronautical Research Labs., Melbourne (Australia).

**A LABORATORY EVALUATION OF LIQUID COOLED VESTS FOR NON-COMBATANTS Final Report, 1980 - 1985**

K. NAGLE and B. A. CLARK Apr. 1986 32 p  
 (AD-A170417; ARL/SYS-TM-87) Avail: NTIS HC A03/MF A01 CSCL 06S

A laboratory experiment was used to assess the value of two commercial liquid cooled vests in alleviating some of the physiological and psychological effects of heat stress on human performance. For conditions of 55 C (dry bulb) and 55% relative humidity, both vests reduced the rate of rise of body temperature, heat storage rate, and mass loss due to thermoregulatory sweating of three subjects. All subjects stated that the vests provided some relief from heat stress, but no effects of heat stress on performance were demonstrated. It suggested that for noncombatant personnel, vests like those tested may provide a practical and economical way of alleviating some of the discomfort and adverse physiological effects of heat stress when environmental control is not practicable.

Author (GRA)

**N87-14857#** Report Store, Lawrence, Kans.

**ANTHROPOMETRIC COMPARISON - USA AND USSR Final Report, Jun. - Aug. 1986**

B. WILLIAMS and L. WASCHER Sep. 1986 29 p  
 (Contract DAAL02-86-P-4734)  
 (AD-A173070; HEL-FIO-6/86) Avail: NTIS HC A03/MF A01 CSCL 06N

This comparison of US/USSR anthropometric dimensions uses illustrations and table formats from the US Army Human Engineering Design Data Digest. US Army figures and tables are shown on the left page and USSR tables are shown on the right page with separate tables for men and women. Each table provides 5th and 95th percentile values in centimeters of Armenian, Russian, and Lithuanian populations. This comparison includes five sets of dimensions: Standing Body Dimensions, Seated Body Dimensions, Circumferences and Surface Dimensions, Head and Face Dimensions, and Anthropometric Data for Workspaces. Detail of some measurements varies between the two countries. USSR illustrations often show the skeletal measurement reference points while US illustrations do not. Each country offers more or less detail on specific anthropometric measures.

GRA

**N87-14858#** Edgerton, Germeshausen and Grier, Inc., Idaho Falls, Idaho.

**HUMAN FACTORS GUIDELINES AND METHODOLOGY IN THE DESIGN OF A USER COMPUTER INTERFACE: A CASE STUDY**

R. E. RICHARDS, W. E. GILMORE, and L. N. HANEY 1986 6 p  
 Presented at the Annual Meeting of the Human Factors Society, Dayton, Ohio, 30 Sep. 1986  
 (Contract DE-AC07-76ID-01570)  
 (DE86-013470; EGG-M-16986; CONF-8609105-3) Avail: NTIS HC A02/MF A01

In this case study, human factors personnel were requested to participate in a project team of programmers and operations specialists to design a cathode ray tube (CRT) display system for a complex process control application. This presentation describes the process and benefits obtained by incorporating human factors guidelines and methods in system design. Standard human engineering guidelines and techniques were utilized by the project

team. In addition, previously published documents and research findings sponsored by the US Nuclear Regulatory Commission (USNRC) were used. Preliminary tasks involved a review of the draft plant procedures. Then, interviews with operators were conducted to establish the initial information for the displays. These initial requirements were evaluated against existing guidelines and criteria to determine the optimal presentation formats. Detailed steps of the approaches used, design decisions made, and tradeoffs that resulted in the final user acceptable design are discussed.

DOE

**N87-14859#** Southampton Univ. (England). Inst. of Sound and Vibration Research.

**WHOLE-BODY VIBRATION AND AIRCREW PERFORMANCE**

M. J. GRIFFIN, R. W. MCLEOD, M. J. MOSELEY, and C. H. LEWIS Jan. 1986 67 p  
 (Contract MOD-AT/2040/0180)

(ISVR-TR-132; ETN-86-98366) Avail: NTIS HC A04/MF A01

The effects of aircraft vibration on vision and manual control performance were studied. Twenty-eight experiments, 16 investigating effects on vision and 12 investigating effects on manual control performance are summarized.

ESA

**N87-14860#** Dornier-Werke G.m.b.H., Friedrichshafen (West Germany).

**LIFE SUPPORT AND ENERGY SUPPLY SYSTEMS FOR MANNED EUROPEAN RETURN SPACECRAFT (TECHNOLOGICAL REQUIREMENTS) [LEBENSHALTUNGS- UND ENERGIEVERSORGUNGSYSTEME FUER BEMANNTE EUROPÄISCHE RUECKKEHRAHRZEUGE (TECHNOLOGIEANFORDERUNGEN)]**

R. REICHERT 1986 23 p In GERMAN Presented at ILA 86 Symposium, Hanover, West Germany, 6 Jun. 1986; sponsored by Hermann-Oberth-Gesellschaft e.V.

(ETN-87-98860) Avail: NTIS HC A02/MF A01

The requirements and technological preparations of the life support and energy supply subsystems for European manned missions are reviewed. Concerning life support systems, mission requirements, specifications, system components, requirements for extravehicular activities, and ESA technology programs are presented. In the field of energy supply (fuel cells), mission requirements, fuel cells and systems components, and ESA technological preparations are outlined.

ESA

**N87-14861\*#** Remic Corp., Elkhart, Ind.

**DEVELOPMENT OF A COMMUNICATION SYSTEM COMPATIBLE WITH CHEMICAL PROTECTIVE CLOTHING AND EQUIPMENT Final Report**

B. D. BLOOD and R. E. RADKE 23 Jun. 1986 126 p  
 (Contract NAS8-36456)

(NASA-CR-177040; NAS 1.26:177040; AD-A170863;

USCG-D-18-86) Avail: NTIS HC A07/MF A01 CSCL 06Q

The U.S. Coast Guard and NASA joined in a project to develop a communications system to operate inside protective suits used in chemical spill response. REMIC Corporation, of Elkhart, Indiana was awarded the contract by NASA for developing this communication system. Coast Guard Strike Teams were consulted to determine operational requirements for the communications system. The contractor also studied environmental problems, investigated the special needs and restrictions of the user, and developed possible package configurations. Various options were presented for Coast Guard consideration with a description of each choice's advantages and disadvantages. NASA and the Coast Guard determined that the suit communication system should be built into a separate light-weight low-profile garment which would not interfere with other equipment being worn. A number of microphone and control options were developed to increase the system's flexibility. Although primarily for totally-encapsulating suits, the system was also designed for use with lower level protective clothing or with ordinary attire. Coast Guard marine band frequencies (157 MHz) were selected for the transceivers and repeaters. Engineering models were presented studied, and modified during a series of review meetings. Prototype transceivers

## 55 SPACE BIOLOGY

and repeaters were fabricated and delivered to the Coast Guard. Field tests with the USCG Pacific Strike Team at Hamilton AFB, California demonstrated that the communications system met the special needs of spill response personnel. Author (GRA)

## 55

### SPACE BIOLOGY

Includes exobiology; planetary biology; and extraterrestrial life.

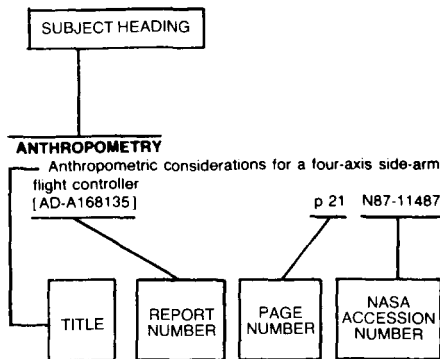
#### A87-16868

##### DISCOVERY OF ORGANIC GRAINS IN COMET HALLEY

D. T. WICKRAMASINGHE (Australian National University, Canberra, Australia) and D. A. ALLEN (Anglo-Australian Observatory, Epping, Australia) Nature (ISSN 0028-0836), vol. 323, Sept. 4, 1986, p. 44-46. refs

The comet Halley has been observed for absorption at a central wavelength of 3.4 microns, and emission at that wavelength is reported. This evidence of organic grains in comets indicates the possible presence therein of a component of similar composition to that found in micrometeorites. Although no definite identification is possible, it is noted that a feature near 3.4 microns is predicted by various models of interstellar dust. C.D.

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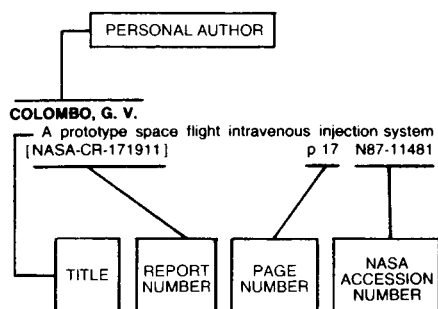
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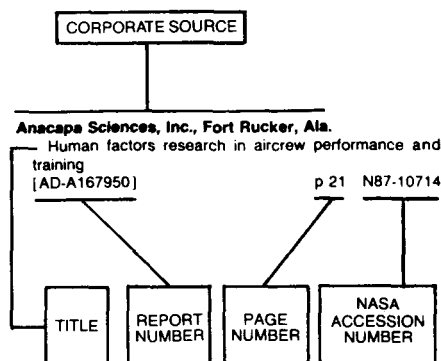
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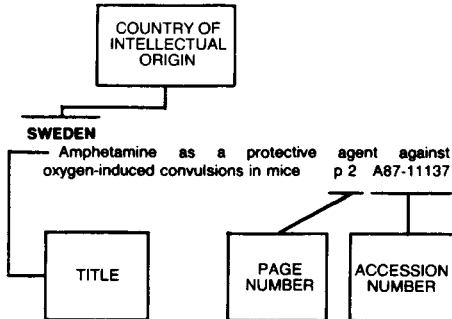
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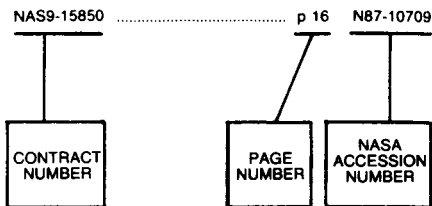
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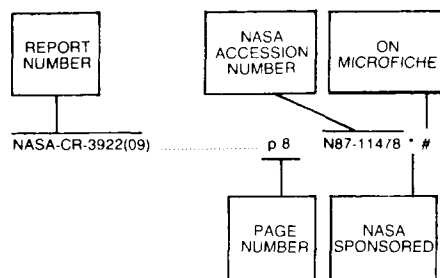


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AEROSPACE MEDICINE AND BIOLOGY / A Continuing Bibliography (Supplement 296)

April 1987

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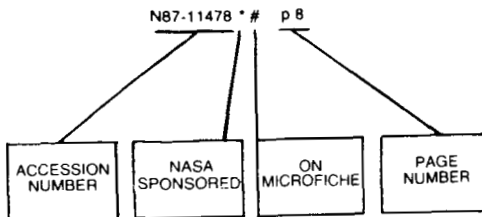
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AEROSPACE MEDICINE AND BIOLOGY / A Continuing Bibliography (Supplement 296)

April 1987

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